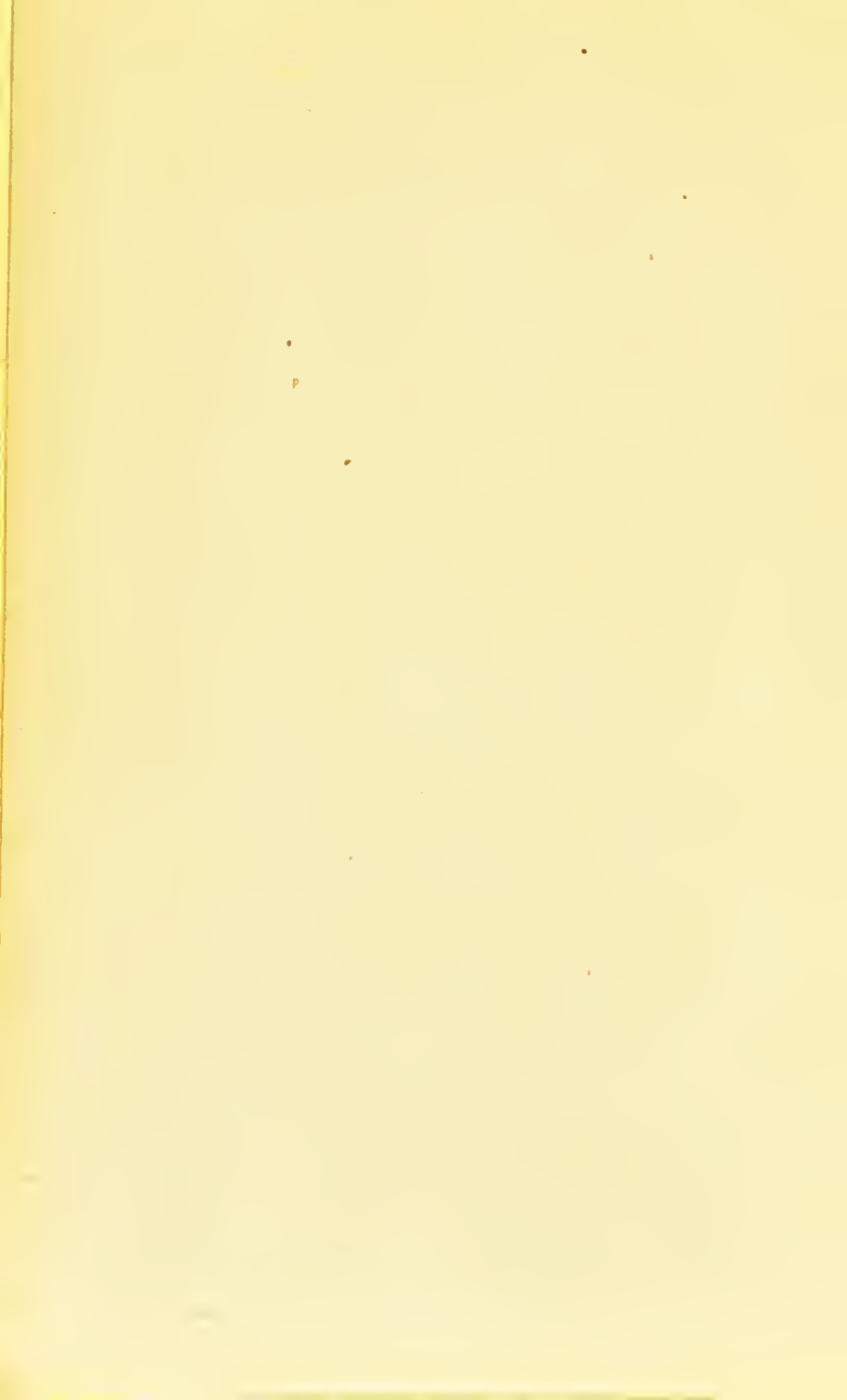


APHORISMS
IN
APPLIED ANATOMY
AND
OPERATIVE SURGERY,
BY
THOMAS COOKE, F.R.C.S

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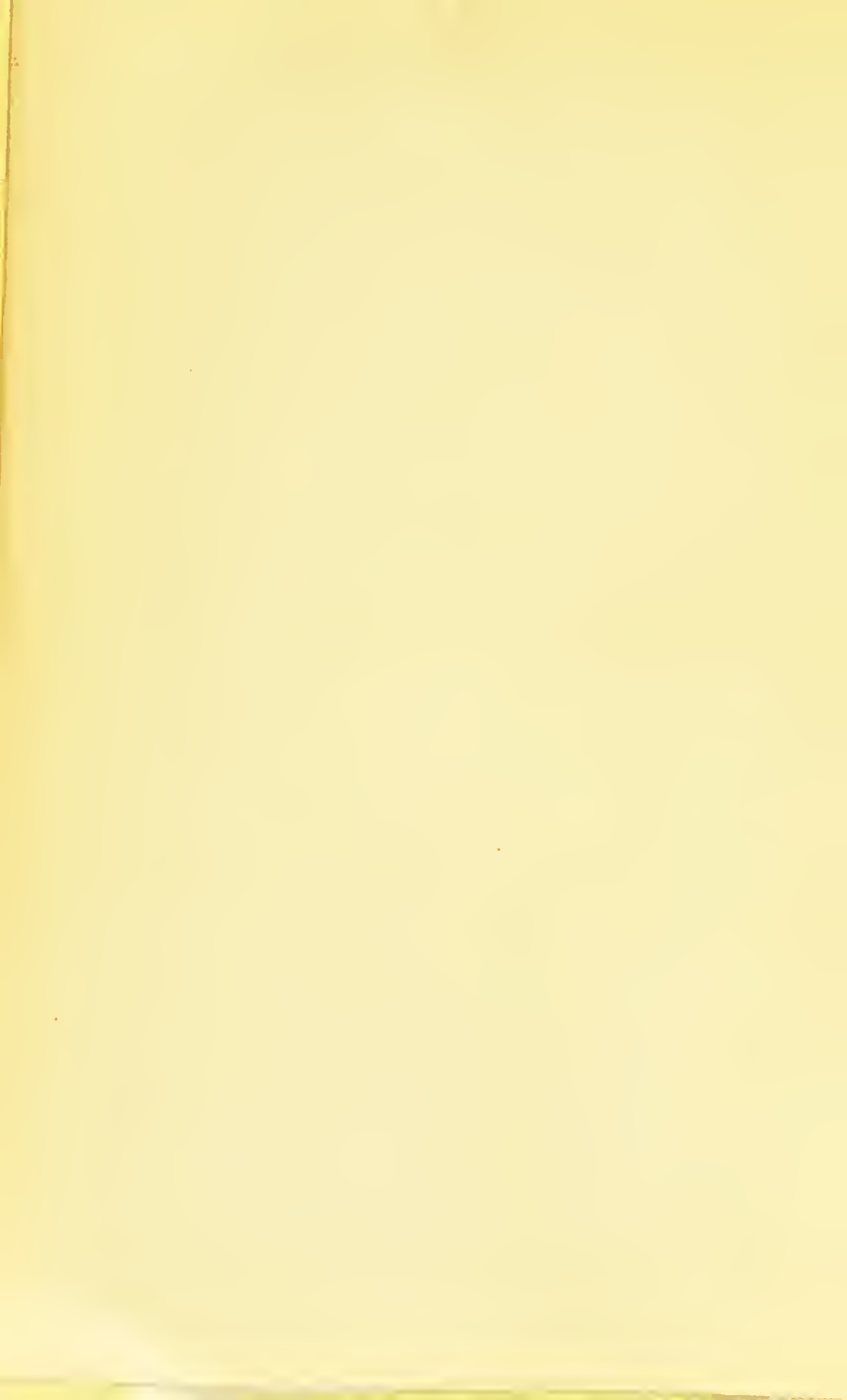
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APHORISMS IN APPLIED ANATOMY

(Or Anatomy for the Final Examinations)

AND

OPERATIVE SURGERY,
INCLUDING 100 TYPICAL VIVÂ VOCE QUESTIONS

IN

SURFACE MARKING, ETC.

BEING NOTES OF DEMONSTRATIONS TO HIS SURGERY CLASS,

BY

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PREFACE.

This little book may be taken as little more than a syllabus of the work done in the Author's courses of operative surgery, preceded by a few notes on the leading points in applied anatomy and surface marking.

It is a characteristic of a syllabus, and of notes, to mention leading points only. This is particularly the case with the "aphorisms," for the following reasons:—

Firstly.—The aphorisms are intended to present such facts only as are susceptible of being tersely stated, and are also easily understood, and easily applied in various ways.

Secondly.—Only those operations are referred to in the aphorisms which it has been considered most advantageous for the average student to perform; and these are outlined only, and mainly from the cadaveric, as opposed to the practical surgical, standpoint.

Thirdly.—All who have worked at operative surgery will have noticed how circuitous and laboured must necessarily be the written description of many procedures, or parts of procedures—*e.g.*, the proper way

of holding a knife—which, on the contrary, are of quite easy demonstration to the assembled class.

The aphoristic method, as the Author understands it, *excludes all such matter*, with a view to its being transferred to the tutorial class—in the present instance, to the Author's class in surgery.

In short, the test whether a given statement should or not find place in the aphorisms has been the question, which the Author has asked himself in every doubtful case,—whether the intelligent and diligent student, reading it in his text-book, would *underline it*, or, hearing it, would *jot it down in his note-book*:

Hence many noticeable omissions.

What has been aimed at is a *suggestive* sketch or outline. The aphorisms are not presented as a superstructure, but as a foundation to be builded upon.

It may perhaps be pleaded that, when a special method of exposition is thought justifiable—be it tabulative or aphoristic, or what not—its drawbacks must in fairness be accepted along with such advantages as it may be considered to present.

The “aphorisms” are intended to favour practical work; and it is believed that it will be found of little use to read the anatomical portion, except one verify at the same time each statement on the exposed body (preferably that of a strong muscular subject) with

both *finger* and *eye*,—or the surgical portion, except when doing or witnessing the operations on the dead body.

It is believed that the aphorisms will fairly cover the ground of the *incidental practical questions* which the vivâ voce examination calls forth, and students are strongly urged to work out PRACTICALLY the answers to at least the hundred “typical vivâ voce questions” in Part III.

It is the Author’s belief that it is in connection with such questions that most men fail at the final examinations, rather than in the more formal written test, for which, of course, all are more or less prepared.

The measurements given are *roughly* correct, sufficiently so for practical purposes.

A reprint of the Tablets of Surgical Anatomy is inserted at the end of Part I.

An appendix should have been added on “SURGICAL DESCRIPTIVE ANATOMY,” *i.e.*, that part of ordinary descriptive anatomy which has a special bearing upon surgery; but, on the whole, it was thought best to refer the reader to the volume of Tablets of Anatomy, simply subjoining a list of the subjects

in descriptive anatomy to which candidates for the final examinations should pay *special* attention.

LIST OF SUBJECTS ("SURGICAL DESCRIPTIVE ANATOMY") TO WHICH THE SENIOR STUDENT SHOULD PAY SPECIAL ATTENTION.

Upper Limb.—Parts about axilla; front of arm and bend of elbow; front of forearm; arteries, veins, and nerves of front of upper limb; palm of hand; parts about shoulder; back of forearm; musculo-spiral and circumflex nerves; joints and ligaments.—*Tablets*, pp. 33 to 60.

Visceral Cavities.—Walls of abdomen; aorta and its principal branches; iliac arteries and their branches; large venous trunks; pelvic fascia; rectum; bladder; coverings of the testicle; testicle and epididymis; vas deferens; vesiculæ seminales and ejaculatory ducts; spermatic cord; prostate gland; male urethra; structure of the penis.—*Tablets*, pp. 110, 125 to 129, 135 to 150.

Lower Limb.—Front of thigh; inner side of thigh; front of leg and dorsum of foot; gluteal region; back of thigh; popliteal space; back of leg; sole of foot; joints and ligaments.—*Tablets*, pp. 61 to 96.

Head and Neck.—Posterior triangle; anterior triangle; parts about the parotid gland; submaxillary region; tongue; pharynx; soft palate; larynx; orbit.—*Tablets*, pp. 163 to 170, 182 to 186, 197 and 198, &c.

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I.

APPLIED ANATOMY.

SHOULDER AND ARM.

Clavicle.—Convex anteriorly, and rounded in its inner two-thirds; concave anteriorly, and flattened from above downwards in its outer third; forms a nearly horizontal buttress, through which the shoulder is supported on the sternum.

Head of the Humerus.—Projects beyond the acromion when the arm hangs down by the side, thus causing the convexity of the shoulder. When the arm is raised, the convexity is replaced by a slight depression, and the head of the humerus can then be felt in the axilla.

The **greater tuberosity** faces in the direction of the outer condyle.

The **articular surface** faces in the direction of the inner condyle.

The **lesser tuberosity** looks forwards and slightly inwards.

The **bicipital groove** faces directly forwards.

The upper epiphysis of the humerus includes the articular surface and both tuberosities.

Coracoid Process.—Its inner border lies behind

the intermuscular space between the deltoid and the pectoralis major. Its apex lies somewhat beneath the deltoid. Both can be distinctly felt when the arm is abducted.

Axillary Artery.—Lies first just to the *inner side of the coracoid process*, and can here be compressed against the second rib, though with difficulty, and not for long. The position of the artery is here indicated by a line drawn from junction of outer and middle thirds of clavicle to outer part of axilla.

Lower down the artery lies *behind the coracobrachialis and short head of the biceps*, on the inner side of the head of the humerus. This being depressed by the raising of the arm, the artery can be compressed against it in the outward direction. The position of the artery is here indicated by a line drawn from junction of the anterior and middle thirds of axilla to a point midway between the condyles of the humerus; which line also indicates, lower down, the position of the brachial artery.

Folds of Axilla. — *Anterior fold* corresponds to fifth rib; *posterior fold* descends a little lower. Highest digitation of *serratus magnus* usually visible in axilla corresponds to sixth rib.

Paracentesis thoracis may conveniently be per-

formed between the fifth and sixth ribs, or between the sixth and seventh, a little above and in front of the lower angle of the scapula.

Boundaries of the Axilla, with their Vessels and Nerves:—

Anterior Wall.—Formed by pectoralis major, behind which is the costo-coracoid membrane and the pectoralis minor. The costo-coracoid membrane is perforated by the anterior thoracic nerves, and by numerous branches of the acromio-thoracic vessels.

Posterior Wall.—Formed by the subscapularis, teres major, and latissimus dorsi. Presents the subscapular vessels and nerves, and the circumflex vessels and nerve.

Inner Wall.—Formed by the serratus magnus, four first ribs, and intercostal muscles. Presents the long thoracic or external mammary artery, with the thoracic branches of the acromio-thoracic and the superior thoracic; also the long thoracic or external respiratory nerve of Sir Charles Bell; also numerous lymphatic glands lying in the course of the lymphatic vessels from the chest wall and breast.

Outer Wall.—Narrow; formed by the biceps and coraco-brachialis, and the humerus. Presents

the axillary artery and vein, and the cords of the brachial plexus.

Apex.—Corresponds to the interval between the clavicle, the first rib, and the upper border of the scapula.

Base.—Formed by the strong deep fascia extending from the pectoralis major to the teres major and latissimus dorsi. It is tensed in the abducted position of the arm, and relaxed in the adducted position, in which latter position the arm should always be placed for the exploration of the axilla.

Deltoid.—Can be raised from the shoulder when the arm is abducted, so as to allow, to some extent, of the formation of a deltoid flap by transfixion. Over its insertion is a slight depression, which was formerly selected as a convenient seat for setons and issues.

Brachial Artery.—Runs along a line drawn from *junction of anterior and middle thirds of axilla* to *midway between condyles of humerus*. It lies just beneath the inner border of the biceps, and is crossed from without inwards by the median nerve. It may be compressed backwards and outwards on the shaft of the humerus along the whole of its course.

Cutaneous Veins.—On the inner side of the artery, in its lower half, is the *basilic vein*, accompanied by the internal cutaneous nerve. The *cephalic vein* runs in the groove on the outer side of the biceps, then between the pectoralis major and the deltoid, and finally opens into the axillary above the coracoid process.

Musculo-Spiral Nerve and Superior Profunda Artery.—Wind obliquely round back of humerus a little above its middle. Below this, for three or four inches above the condyles, there is nothing to interfere with operations on the bone.

Bend of the Elbow.—In a muscular limb it forms a triangular depression, bounded internally by the *pronator radii teres*, externally by the *supinator longus*, and above by the projection of the *brachialis anticus* and biceps. The tendon of the biceps can here be felt, with the brachial artery on its inner side; more internally is the median nerve.

In front of the artery, separated from it by the bicipital or semilunar fascia, is the *median basilic vein*, running upwards and inwards, and accompanied by the anterior branches of the internal cutaneous nerve. Externally is the *median cephalic vein*, somewhat smaller, running upwards and outwards, accompanied by the anterior branches of the

musculo-cutaneous or external cutaneous nerve. The *musculo-spiral nerve* is deeply situated behind the musculo-cutaneous, between the brachialis anticus and the supinator longus. At the apex of the triangle is the termination of the *median vein*.

The circulation in the brachial artery may be completely arrested by forcible flexion of the forearm upon the arm.

Skeleton of the Elbow.—**Internal condyle** more prominent than the external, and situated a little higher; **external condyle** less prominent than the internal, and situated a little lower.

Olecranon lies nearer to the inner than to the outer condyle. Between it and the inner condyle is a groove ("funny bone") containing the ulnar nerve and the posterior ulnar recurrent artery.

In extension the *top of the olecranon* is in the horizontal line of the condyles; in the intermediate position it lies below and behind them; in complete flexion, below and in front. There is a bursa over it (miner's bursa).

The **head of the radius** lies just below the external condyle, beneath a little pit or dimple of the skin. It can easily be felt when the forearm is rotated.

A Lymphatic Gland lies just above and in front of the internal condyle.

FOREARM AND HAND.

Ulna.—The **shaft** can be traced along its whole length, its posterior border being everywhere subcutaneous.

The **head** forms a distinct rounded prominence at the back of the wrist, especially evident in pronation.

The **styloid process** lies farther back than that of the radius, and does not descend so low; its apex marks the level of the radio-carpal joint. Between it and the back of the head is the groove for the *extensor carpi ulnaris*.

Radius.—Only the lower half of its shaft can well be felt, the upper half being covered by muscles. Its lower expanded extremity presents externally the **styloid process**, which is situated further forwards and descends lower down than that of the ulna; and then, from without inwards, the following **tendinous grooves**, each lined by a synovial sheath:—

1. Broad and shallow groove, divided in two by a slight ridge, for *extensores ossis metacarpi* and *primi internodii pollicis*;

2. Broad and shallow groove, similarly divided, for *extensores carpi radialis longior* and *brevior*;
3. Narrow and deep groove, for *extensor secundi internodii pollicis*;
4. Broad and shallow groove, for *extensores indicis* and *communis digitorum*.
5. Half groove, completed internally by head of ulna, for *extensor minimi digiti*.

Back and Outer Side of the Wrist.—The above-mentioned extensor tendons are distinctly visible when the muscles are brought into action. The corresponding synovial sheaths extend from a little above the posterior annular ligament almost to the phalangeal insertions.

“Anatomical Snuff-box.”—Comprised between the *extensores ossis metacarpi* and *primi internodii pollicis*, on the one hand, and the *extensor secundi internodii* on the other, and deeply hollowed out when the thumb is forcibly extended. Over it runs the radial vein. The *radial artery* crosses it deeply, running along a line drawn from the apex of the styloid process of the radius to the uppermost part of the first interosseous space. Towards its middle can be felt the projection of the upper end of the metacarpal bone of the thumb.

Carpus.—The *tubercle of the scaphoid* can be felt below and in front of the styloid process of the radius. Below it can be felt the *trapezium*, though less distinctly, as it is covered by the muscles of the thenar eminence. Below, and a good way in front of the styloid process of the ulna, is the rounded prominence of the *pisiform bone*. Below this is the indistinctly felt prominence of the *unciform process* of the unciform bone. The *cuneiform bone* can be distinctly felt at the back of the carpus, a little below the head of the ulna.

Joints of the Fingers.—Notice on the skeleton that, in the extended position, the metacarpal bones and phalanges are placed end to end, and that, in the flexed position, the distal bone is found in front of the proximal one. The line of articulation lies, therefore, in the flexed position of a joint, at a distance from the corresponding knuckle (or projection of the proximal bone behind) equal to thickness from before backwards of the distal extremity of the proximal bone.*

The position of the *joint of the metacarpal bone of the thumb* is indicated by the above-mentioned

* This fact will prove, it is believed, the surest guide to the situation of the joints of the fingers. The flexion lines on the palmar aspect of the fingers are all wrong as guides to the joints, except the second one from the tip of the finger. The first one from the tip is much above, and the third one much below, the corresponding joint.

projection of the metacarpal bone at the bottom of the "anatomical snuff-box."

Radial Artery.—Runs along a line drawn from *midway between condyles of humerus* to a point *just internal to the styloid process of the radius*. In the upper third of its course it is covered by the *supinator longus*. Lower down it lies in the groove between the tendon of that muscle and that of the *flexor carpi radialis*. The *radial nerve* lies close to the outer side of the artery in the middle third of the forearm, but is distant from it both above and below. At the wrist the radial artery gives off the *superficialis volæ*, which crosses the thenar eminence, and sometimes pulsates distinctly.

Ulnar Artery.—Runs deeply at first from the bend of the elbow to near the middle of the inner border of the forearm. It then descends more superficially between the *flexor carpi ulnaris* and the *flexor sublimis digitorum*. Here it runs along a line drawn from *the inner condyle*, or a point *a little external to it*, to a point *a little external to the pisiform bone*. The *ulnar nerve* lies close to the inner side of the artery in the lower two-thirds of its course.

Superficial Palmar Arch.—Crosses palm of hand about junction of middle and upper thirds, opposite lower border of abducted thumb. **Deep**

palmar arch lies half an inch higher up. The *superficial palmar interosseous* (or digital) *arteries* run *towards the clefts* between the fingers, and lie, therefore, *between* the shafts of the metacarpal bones. Incisions in the palm below the line of the thumb should be made towards the fingers—that is to say, *over* the metacarpal bones. Upon the fingers, the digital arteries run along the sides of the sheaths behind the corresponding nerves. Incisions to open thecal abscesses should be made over the middle line of the finger.

Front of the Wrist.—Shows, in forcible flexion, the tendons of the *flexor carpi radialis* and *palmaris longus*. The *median nerve* lies close to the inner border of the former. (The *palmaris longus* is sometimes absent.)

The *lower of the transverse furrows* here visible corresponds to the upper edge of the anterior annular ligament, and to the medio-carpal joint.

The synovial sheath common to the *flexores sublimis* and *profundus*, and that of, the *flexor longus pollicis*, extend an inch and a half above the upper edge of the anterior annular ligament. Inferiorly these sheaths communicate with the special sheaths of the thumb and little finger, but not with those of the index, middle, and ring fingers, ending, as regards these fingers, about the middle of the palm.

Transverse Furrows in the Palm.—The lowest one, which crosses the palm about its lower third, marks the upper limit of the synovial sheaths of the index, middle, and ring fingers, and the division of the superficial palmar interosseous arteries into the digital proper. The other furrows are unimportant.

Back of the Hand.—Here again the *dorsal interosseous arteries* run upon the interosseous spaces, and incisions should be made towards the fingers, or *over* the metacarpal bones.

ABDOMEN.

Linea Alba.—Is the thinnest, least vascular, and non-muscular part of the abdominal wall. It is here that we make the incision for laparotomy. Behind it lie from above downwards the left lobe of the liver, the stomach, the transverse colon, the small intestine, and the bladder when distended, the anterior surface of the latter being then uncovered by peritoneum.

Lineæ Transversæ.—Generally three, the lowest being situated a little above the umbilicus; sometimes a fourth one below the umbilicus. Unimportant surgically.

Lineæ Semilunares.—Correspond to the division of the abdominal aponeuroses to form the sheaths of the recti. It is over the upper part of the left one, just below the costal cartilages, that the incision is made for gastrostomy.

Abdominal Aorta.—Bifurcates on the left side of the fourth lumbar vertebra, about *an inch and a half below, and a little to the left of*, the umbilicus, on a level with the highest part of the crest of the ilium.

Iliac Arteries.—Curve downwards and outwards from the above point to midway between the anterior superior spine of the ilium and the symphysis pubis, the *upper two inches* of the curve corresponding to the common iliac, and the remainder to the external. The arteries rest, though not directly, upon bone, and can be compressed through the abdominal wall. They can also be compressed on either side by Davy's rectal lever, the rectum yielding somewhat when compression is made on the artery of the right side.

Umbilicus.—Lies opposite the *third lumbar vertebra*. *A little below and to the left of the umbilicus*—that is just above the bifurcation of the artery—is the best place at which to compress the abdominal aorta. Here the artery has emerged from beneath the transverse duodenum and pancreas, there is but the small intestine in front of it, and the renal vessels are well out of the way.

Spine of the Pubes.—Can easily be felt by pushing up the skin of the scrotum, or, to some extent, that of the labium, and thus getting the finger beneath the subcutaneous fat. Should there be a difficulty in finding it in the female, the tendon of the *adductor longus*, when tensed, will lead up to it. The external abdominal ring and inguinal hernia lie

above and internal, and the femoral ring and hernia below and external to it.

External Abdominal Ring.—Triangular, and oblique downwards and inwards; about an inch long and half an inch wide in the male, but rather smaller in the female. Can easily be felt by invaginating the skin as above. In the normal condition it will admit the tip of the little finger. The spermatic cord can be felt emerging from it in the male.

The external abdominal ring is bounded externally by its *outer or inferior pillar*, which is attached to the *spine of the pubes*; internally by its *inner or superior pillar*, which *decussates with its fellow in front of the symphysis pubis*; below by the crest of the pubes; above by the intercolumnar fibres. From these latter there is continued downwards the *intercolumnar or external spermatic fascia*, which is closely adherent to the margins of the ring, and is prolonged inferiorly into a tubular process round the cord and testis.

Internal Abdominal Ring.—Lies about *half an inch* above Poupart's ligament, midway between the anterior superior spine of the ilium and the spine of the pubes. The deep epigastric artery runs upwards and inwards along its lower and inner boundaries.

The internal abdominal ring is a tubular opening in the fascia transversalis formed by the prolongation

of that fascia round the cord and testis (infundibuliform fascia, fascia propria). It is oval, with long diameter directed downwards and outwards. It is bounded above and externally by the lower arched fibres of the internal oblique and transversalis, below and internally by the deep epigastric vessels.

Inguinal Canal.—Runs obliquely downwards and inwards above the inner half of Poupart's ligament. Is from an inch and a half to two inches long.

Its boundaries are as follows:—

IN FRONT.—Aponeurosis of *external oblique* along its whole length; lower arched fibres of *internal oblique and transversalis* along its outer third.

BEHIND.—*Fascia transversalis* along its whole length; *conjoined tendon* of internal oblique and transversalis, and also the *triangular ligament*, along its inner third.

ABOVE.—*Lower arched fibres of internal oblique and transversalis*.

BELOW.—*Poupart's ligament* blended posteriorly with the fascia transversalis.

Deep Epigastric Artery.—Runs from inner border of internal abdominal ring to middle of the rectus muscle. The incision for *ligature of the common, or upper part of the external iliac artery*, should lie entirely on its outer side. For ligature of the lower

part of the external iliac artery, the incision may be made internal to the artery ; but this is not, as a rule, a good operation.

Abnormal Obturator Artery.—Spine of ilium, Poupart's ligament, glands of groin.
—See “ Lower Limb.”

Liver.—The greater part of its *anterior border* corresponds to the lower border of the right costal cartilages ; in the middle line, however, it descends to about midway between the ensiform cartilage and the umbilicus. Its *convex surface* rises on the right side, anteriorly, to about an inch below the nipple ; posteriorly, to the tenth dorsal spine. On the left side it does not rise quite so high. The fundus of the gall bladder lies opposite the tip of the ninth costal cartilage of the right side.

Stomach.—When empty, lies quite at the back of the abdomen, overlapped by the liver. When distended, it turns upwards on its lesser curvature, its anterior and posterior surfaces becoming respectively superior and inferior, and its greater curvature, an anterior border. The stomach then displaces contiguous organs in every direction, and occupies the greater part of the left hypochondriac and epigastric regions. The cardia, the least movable portion, lies just below the junction of the seventh left costal

cartilage with the sternum. The pylorus, though extremely movable, may be said to lie near the junction of the eighth right costal cartilage with its rib.

Pancreas.—Lies behind the transverse colon, opposite the second lumbar vertebra, about two or three inches above the umbilicus.

Large Intestine.—The *transverse colon* lies in front of the pancreas, two or three inches above the umbilicus. The *cæcum* occupies the right iliac fossa, the *sigmoid flexure* the left. The *ascending* and the *descending colon* lie in right and left lumbar regions, in front of corresponding kidney. They may be reached by an incision made downwards and outwards between the last rib and the crest of the ilium, and beginning at the outer border of the erector spinæ, the centre of which should correspond to a point midway between the anterior superior and posterior superior iliac spines.

Kidney.—Lies opposite the two lower dorsal and two upper lumbar spines, in front of the two last ribs and projecting below them, the right one descending lower than the left. The kidney may be reached by the same incision as the colon, or a T-shaped incision may be required. Some surgeons

prefer the incision downwards and forwards from the last rib to the anterior superior spine of the ilium, which is sometimes made for the ligature of the common iliac artery.

Spleen.—Lies beneath the ninth, tenth, and eleventh left ribs, between the “axillary lines” drawn vertically downwards from the anterior and posterior boundaries of the axilla. It cannot be felt below the ribs, unless it be enlarged.

LOWER LIMB.

Poupart's Ligament.—From anterior superior spine of ilium to spine of pubes. Convex downwards and outwards. *External abdominal ring and inguinal hernia* lie above and internal, and *femoral ring and hernia* below and external, to it.

In the *flap amputation at the hip*, the knife should be entered parallel to Poupart's ligament, and close to it, when it will probably open the capsule of the joint.

Fold of the Groin.—Due to adhesion of deep layer of superficial fascia to Poupart's ligament. Urine extravasated through rupture of membranous portion of urethra infiltrates first the scrotum, and then the superficial fascia of the abdomen—not that of the thigh, on account of this adhesion.

Lymphatic Glands (two sets).—**Inguinal:** Lie just below and parallel to inner half of Poupart's ligament; receive lymphatics of penis, scrotum, perinæum, lower part of abdomen, and buttock. **Femoral:** Situated lower down, on outer side of

internal saphenous vein; receive lymphatics of lower limb, and some of those of scrotum.

Saphenous Opening.—Situated *an inch and a half* below and external to spine of pubes, below junction of inner and middle thirds of Poupart's ligament. Is covered in by the cribriform fascia. Its *outer boundary* is prominent and well defined, and formed by the iliac portion of the fascia lata; its *inner boundary* is depressed and less clearly defined, and formed by the pubic portion.

Femoral Ring.—May be defined by feeling for the pulsation of the femoral artery on the pubes, and allowing half an inch on the inner side of the artery for the femoral vein; the ring is just internal to the vein. It lies about half an inch higher than the saphenous opening, immediately under the inner part of Poupart's ligament.

It is bounded internally by the sharp, cutting edge of Gimbernat's ligament; behind by the pubes, covered by the pectineus muscle; externally by the femoral vein; and above by Poupart's ligament, with the deep crural arch, and in the male the spermatic cord. On its inner side there may be an abnormal obturator artery; this occurs when the obturator artery presents the double abnormality of arising from the epigastric, and of arising from the epigastric at some distance

from the origin of the latter from the external iliac. In this case the trunk common to the two arteries passes inwards above the femoral ring, and then the obturator artery descends into the pelvis on the inner side of the ring, behind Gimbernat's ligament.

Anterior Superior Spine of Ilium.—The most convenient point from which to measure the relative length of the two lower limbs in suspected fracture, dislocation, or hip-joint disease.

Great Trochanter.—Lies in a line drawn from anterior superior spine of ilium to most prominent part of tuberosity of ischium (*Nelaton's line*). It is more convenient, however, as a test of dislocation or fracture, to compare on the two sides the vertical distance between the great trochanter and the anterior superior spine of the ilium (*Bryant's test*). The upper part of the great trochanter is nearly on a level with the spine of the pubes.

Sartorius Muscle.—Easily defined on the living by instructing patient to raise his leg over thigh of opposite side. Forms outer border of Scarpa's triangle, at apex of which it *crosses femoral artery three or four inches below Poupart's ligament*. Further down, over Hunter's canal, the muscle becomes somewhat internal to the artery.

Femoral Artery.—Along *upper two-thirds of a line* drawn from *midway between anterior superior spine of ilium and symphysis pubis to inner side of inner condyle of femur*. Gives off the profunda from *one and a half to two inches* below Poupart's ligament. Is crossed by the sartorius at apex of Scarpa's triangle, *three or four inches* below same ligament. In middle of thigh, it lies in Hunter's canal, beneath outer border of sartorius. Can best be compressed directly backwards on pubes. Can also be compressed outwards against femur at apex of Scarpa's triangle.

Femoral Vein.—Lies close to inner side of artery at brim of pelvis, but soon gets behind it; lies behind it and to its outer side in Hunter's canal.

Anterior Crural Nerve.—Enters thigh half an inch on outer side of femoral artery. The *long saphenous nerve* accompanies the artery in Hunter's canal, lying in front of it and to its outer side.

Gluteal Artery.—Emerges from upper part of great sacro-sciatic foramen at junction of middle and upper thirds of a line drawn from posterior superior spine of ilium to great trochanter when limb is rotated slightly inwards.

Pudic and Sciatic Arteries.—Emerge from

lower part of same foramen at junction of middle and lower thirds of a line drawn from posterior superior spine of ilium to outer part of tuberosity of ischium.

Fold of Buttock.—Corresponds pretty nearly to lower border of gluteus maximus; is lowered in downward dislocations of the hip, and somewhat effaced in hip-joint disease.

Great Sciatic Nerve.—Can easily be exposed by an incision downwards from above fold midway between great trochanter and tuberosity of ischium; it lies on the outer side of, and then just beneath, the biceps.

Patella.—Its *inner border*, which is more prominent than the outer, lies in a line with the big toe. The *apex* of the patella, the *ligamentum patellæ*, the *tubercle of the tibia*, and the *middle of the ankle-joint* are also in a line one with another.

In extension, the patella lies almost entirely above the femoral condyles. In flexion, it corresponds to the intercondyloid notch, and rests mainly on the outer condyle.

Bursa Patellæ.—Lies partly over lower part of the patella, and partly over the *upper part of the*

patellar ligament. Care must be taken, in excising the hypertrophied bursa, not to open the capsule of the knee-joint. There is a bursa beneath the ligamentum patellæ.

Synovial Membrane of Knee-Joint.—Rises, in the extended position, about *two inches* above the upper border of patella, or even a little higher, especially on the inner side; in flexion it does not rise quite so high. Inferiorly, it descends as low as the upper part of the head of the fibula. It not unfrequently communicates with the synovial membrane of the superior tibio-fibular articulation.

Popliteal Space.—Broad above, where it is bounded externally by the strong tendon of biceps passing down to the head of the fibula, and internally by the thin prominent tendon of the semitendinosus, internally to which is the thick rounded tendon of semimembranosus. Narrow below, where it is bounded on either side by the two heads of the gastrocnemius, the outer head having the plantaris beneath it.

Bursæ in Popliteal Space.—*Externally*, one beneath outer head of gastrocnemius, which sometimes, and one beneath tendon of popliteus, which almost always, communicates with knee-joint. *Internally*, one beneath inner head of gastrocnemius (between it and semimembranosus and posterior liga-

ment of knee-joint) ; also one beneath tendon of semimembranosus. From Holden's dissections, it seems to be the former, and not the latter, which is frequently enlarged, and sometimes communicates with the knee-joint.

Popliteal Artery.—First obliquely downwards and outwards from opening in lower part of adductor magnus, then vertically downwards to lower border of popliteus, where it divides, an inch below the tubercle of the tibia, into anterior and posterior tibial. In the greater part of its course it has the vein posterior and external and close to it, and the internal popliteal nerve posterior and external to, and at a distance from, both vessels. Quite at the lower part of the popliteal space, both the vein and the nerve become internal to the artery. The external popliteal nerve lies in the outer part of popliteal space, close to the tendon of the biceps.

Fibula.—**Head**, prominent at lower, outer, and back part of knee-joint, about *an inch below the line of articulation*. Its upper extremity marks the lower boundary of the synovial membrane of the knee-joint. **Shaft**, oblique downwards and backwards; subcutaneous in lower third. **External malleolus**, pointed; situated lower down and further back than the internal; marks outer extremity of incisions for

Syme's and Pirigoff's amputations. The external saphenous vein and nerve lie behind it.

The base of the fifth metatarsal bone lies about *two inches* in front of external malleolus. Midway between the two bony processes is the line of Chopart's medio-tarsal amputation, the exact position of which is marked by the projection of the os calcis, termed the *tubercle of Chopart*.

Internal Malleolus.—Broader and situated *further forward* than, but *not so low* as, the external. The line of the ankle-joint lies about half an inch above its lower extremity. The internal saphenous vein and nerve lie in front of it. The posterior tibial artery can be felt beating about half an inch behind it and to its outer side.

About an inch in front of it is the *tubercle of the scaphoid*; and a little below and behind the two bony processes is the *lesser process of the os calcis*, or sustentaculum tali.

Structures behind the Malleoli.—*Behind the internal malleolus* there comes first the tendon of the tibialis posticus nearest the surface, then the tendon of the flexor longus digitorum, then in succession the posterior tibial artery with a vein on either side, the posterior tibial nerve, and, finally, the tendon of the flexor longus pollicis. *Behind the external*

malleolus are the two peronei muscles, the brevis being in front of the longus. The sheaths of all the above tendons extend about an inch and a half above the malleoli. To keep clear of them in tenotomy, it is about two inches above the malleoli that the tendons should be cut.

Anterior Tibial Artery.—Somewhat smaller than the posterior. Runs along a line drawn from a point *a little internal to head of fibula to midway between the two malleoli*, lying in succession between tibialis anticus and extensor longus digitorum, between tibialis anticus and extensor proprius pollicis, between tendon of extensor longus pollicis, which crosses it, and extensor longus digitorum. The anterior tibial nerve is first on its outer side, then in front of it, then again to its outer side. It is deep above, and superficial below, where it can be felt beating upon the tibia midway between the two malleoli.

Posterior Tibial Artery.—Somewhat larger than the anterior. Lies at first an inch external to inner border of tibia. It is here covered by inner head of gastrocnemius and soleus, the latter muscle having a *glistening layer of fascia on its anterior surface*. Further down, it lies beneath skin and fascia only between tendo Achillis and inner border of tibia. In both situations it rests upon deep muscles of back of leg,

and has the posterior tibial nerve on its outer side. It can be felt half an inch behind and external to the internal malleolus.

On Inner Side of Foot.—Is the prominent projection of the *tubercle of the scaphoid*, which, as regards the skin incisions, is the guide to Chopart's, or the medio-tarsal, amputation. It lies *an inch* in front of the internal malleolus, and between and a little behind the two bony processes is the lesser process of the os calcis, or sustentaculum tali. *An inch and a half* in front of the tubercle of the scaphoid is the line of Lisfranc's, or the tarso-metatarsal, amputation.

On Outer Side of Foot.—Is the prominent projection of the *base of the fifth metatarsal bone*, which lies about two inches in front of the external malleolus, and is the best guide to Lisfranc's amputation. Midway between it and the external malleolus is the line of the medio-tarsal, or Chopart's, amputation, the precise position of which is indicated by the projection of the os calcis, termed the *tubercle of Chopart*.*

* N.B.—In Lisfranc's amputation, one and the same guide, the base of the fifth metatarsal bone, serves both for the skin incisions and for the disarticulation. In Chopart's amputation, there is one guide for the skin incisions, the tubercle of scaphoid, and another for the disarticulation, the tubercle of the os calcis or tubercle of Chopart. As these latter tubercles are opposite each other, it may be wondered why the description of the operation is complicated by two guides being given instead of one. The reason is that, while the tubercle of Chopart stands

Dorsalis Pedis Artery.—Extends from midway between the malleoli to back part of first interosseous space, lying on bones of tarsus between tendon of extensor proprius pollicis and innermost tendon of extensor brevis digitorum, which latter crosses it near its termination. It has the anterior tibial nerve on its outer side.

Internal Plantar Artery.—Runs between flexor brevis digitorum and abductor and flexor brevis pollicis, from inner side of os calcis towards middle of big toe.

External Plantar Artery.—Runs beneath flexor brevis digitorum from same point to base of fifth metatarsal bone, and then deeply across sole of foot to back of first interosseous space, where it joins with communicating branch of dorsalis pedis.

up in front of the cuboid in such a way that the knife placed against it is bound to enter the joint at once, and thus the tubercle is the best possible guide for opening the joint, it is, on the other hand, not nearly so prominent, before the skin is divided, as is the tubercle of the scaphoid, and is therefore not so good a guide for the skin incisions. The tubercle of the scaphoid, on the other hand, though a better guide for the skin incisions, is not so good a guide to the articulation, which is here a curved line more difficult to find than the straight line of the calcaneo-cuboid joint.

THE HEAD.

The Scalp.—Is firmly connected to the tendon of the occipito-frontalis, and moves with it. A scalp wound will generally divide the tendon.

Tendon of the Occipito-Frontalis.—Is but loosely connected to the pericranium. Between the two is a stratum of loose cellular tissue, which easily becomes the seat of diffuse inflammatory infiltration and sloughing.

Arteries of the Scalp.—*Frontal*, emerging from the superior internal angle of the orbit. *Supra-orbital*, emerging from supra-orbital notch or foramen at junction of inner and middle thirds of supra-orbital arch. *Temporal*, running between condyle of lower jaw and external auditory meatus, and then crossing the posterior root of the zygoma; divides into anterior and posterior branches. *Posterior auricular*, over front part of mastoid process. *Occipital*, about midway between mastoid process and external occipital protuberance. All these arteries are subcutaneous.*

External Occipital Protuberance.—Always perceptible to the finger. Corresponds to the torcular

* One is well repaid for a perusal of Mr. Treves's excellent chapter on the Scalp. See Treves's "Applied Anatomy."

Herophili. Gives attachment to the ligamentum nuchæ. From either side of it spring the superior curved lines of the occipital bone, which give attachment to the trapezius, sterno-mastoid, and occipito-frontalis. The inferior curved lines are out of reach of the finger.

Frontal Sinuses.—Do not exist in childhood. They are formed, as age advances, by the separation of the two tables of the skull. The absence of the usual external prominence does not necessarily indicate the absence of the sinuses, which may be formed by the retrocession of the inner table of the skull. Neither does a prominent bump necessarily imply a large sinus. The same remark applies to the mastoid cells.

Lateral Sinus.—Runs in its horizontal portion along a line drawn from the external occipital protuberance to the external auditory meatus, grooving the posterior inferior angle of the parietal. In its descending portion it follows the anterior border of the mastoid process.

Lower Levels of the Brain.—The line of the horizontal portion of the lateral sinus, prolonged along the posterior half of the lower border of the zygoma, marks the lower level of the posterior and middle lobes. The lower level of the anterior lobe is marked by a line drawn through the superciliary

ridges to a point three-quarters of an inch behind either temporal ridge.

Middle Meningeal Artery.—Crosses the anterior inferior angle of the parietal about *an inch and a half behind*, and *half an inch above*, the external angular process of the frontal bone (or an inch and a quarter above the zygoma—*Treves*).

Rules for Exposing the Motor Centres of the Cerebral Cortex.—First find the bregma, or point of junction of the coronal and sagittal sutures, by drawing a line over the vertex from one external auditory meatus to the other, the head being in the usual erect position.

Then define the **fissure of Rolando**. This runs downwards and forwards from a point $5\frac{1}{2}$ centimetres behind the bregma to a point 3 centimetres above and 7 centimetres behind the external angular process of the frontal.

The motor centres are grouped round the fissure of Rolando, and lie, roughly speaking, as follows:—Those corresponding to the *lower limb*, behind the upper part of the fissure; those corresponding to the *upper limb*, around the middle of the fissure; and those corresponding to the *muscles of the face*, below and in front of the fissure.

External Auditory Canal.—Runs forwards and inwards, with a slight concavity downwards, and

is *an inch and a quarter* long in the adult. To straighten the canal for inspection the auricle should be drawn upwards and backwards. The *membrana tympani* is oblique downwards and inwards. It is slightly concave, and the handle of the malleolus can be seen adhering to its upper half.

FACE.

Branches of the Fifth Nerve and Corresponding Vessels.—The *supra-orbital* nerve and artery emerge from the orbit through the supra-orbital notch or foramen at junction of inner and middle thirds of supra-orbital arch. The *infra-orbital* and *mental* foramina, with the corresponding vessels and nerves, are in a line drawn from this point to the interval between the bicuspid teeth of the lower jaw. The *auriculo-temporal nerve* emerges from under cover of the parotid gland behind the temporal artery, and accompanies the two branches of the latter.

Condyle of the Lower Jaw.—Can be felt, when the mouth is opened and shut, to glide forwards and backwards upon the eminentia articularis, in front of the external auditory meatus.

Ramus of the Jaw.—Incisions made over this should be horizontal in direction, so that they may avoid both Steno's duct and the faeial nerve. *Steno's duct* runs along a line from the lower part of the coneha to a point midway between the free margin of the lip and the ala of the nose. The trunk of the *faeial nerve* passes downwards and forwards from the

point where the anterior border of the mastoid process meets the ear.

Facial Artery.—Crosses the lower jaw in front of the masseter, where it can be felt and compressed. It passes upwards and forwards to near the angle of the mouth, where it lies close to the mucous membrane, and can be felt and compressed from within. Its coronary branches also lie near to the mucous membrane. The artery then ascends along the side of the nose to a little to the inner side of the tendo oculi, where it joins with the nasal branch of the ophthalmic.

Puncta Lachrymalia.—The lower one is slightly the larger, and the more external. The lower lachrymal canal runs first downwards and then inwards, forming an angle, which the surgeon obliterates, before introducing Weber's knife, by drawing the lower lid outwards.

Tendo Oculi.—Crosses the lachrymal sac a little above its middle. It is easily seen when made tense by drawing the lower lid outwards. A puncture just below it would enter the lower part of the lachrymal sac.

Nasal Duct.—Runs downwards, backwards, and outwards. It is from half to three-quarters of an inch in length, and ends in the inferior meatus of

the nose. Its *inferior aperture* is sometimes on the roof of the meatus, when it is large and round, and sometimes on the outer wall of the meatus, when it is smaller and slit-like.

The Skin of the Nose.—Is firmly connected to the cartilages; hence the acute pain felt in erysipelas and small boils on the nose.

The Nostril, or Anterior Aperture of the Nose.—Is on a lower level than the floor of the nasal fossa. When raised, it allows of the inspection of the lower part of the nasal cavity, including the inferior turbinated bone.

Septum Nasi.—Is generally deviated a little to one side or other, narrowing the nasal fossa of that side.

Coronary Arteries.—Surround the buccal aperture lying close to the mucous membrane, and can be compressed from within the mouth in the operation for hare-lip.

Steno's Duct.—Runs along a line drawn from the lower part of the concha to a point midway between the free margin of the lip and the ala of the nose, and opens on the summit of a small papilla opposite the second molar tooth of the upper jaw.

The Tongue.—Is rough over the anterior two-thirds of its dorsum, and smooth posteriorly. On its under surface, in front of the frenum, it presents a narrow median furrow. On either side of this are the ranine veins; these indicate the position of the corresponding arteries. The middle line of the tongue is but slightly vascular.

The Sublingual Glands.—Stand out on the floor of the mouth on either side of the frenum. On their inner side we find the sublingual artery, which is endangered when the frenum is too freely divided.

Tendons of the Genio-Hyo-Glossi.—May be felt in the middle line of the floor of the mouth, just behind the jaw-bone. Their division allows the tongue to be drawn very freely out of the mouth, as may be necessary in the removal of a cancer of the organ.

At the outer and back part of the hard palate can be felt the **hamular process of the sphenoid**. A little in front of this the *posterior palatine artery* emerges from the posterior palatine canal—a point to be borne in mind in ouranoplasty.

The Tonsil.—Lies between the anterior and posterior pillars of the fauces, in close proximity to the

internal carotid artery, between which and the tonsil are only the superior constrictor muscle and the fibrous wall of the pharynx. Externally, the tonsil corresponds to the angle of the jaw.

The Pterygo-Maxillary Ligament.—May be felt, behind the last molar tooth and below and in front of the tonsil, passing down from the hamular process to the back part of the mylo-hyoid ridge of the lower jaw. A little below it is the *gustatory nerve*, pressure upon which causes acute pain. Division of the nerve gives temporary relief in cancer of the tongue.

For the examination of the throat, the head should be thrown well back, and the nostrils pinched. The soft palate is then instinctively raised in order to facilitate breathing through the mouth. On the nostrils being relaxed, the soft palate will become pendulous, when the finger can be passed behind it to explore the posterior aperture of the nares.

THE NECK

Parts in the Middle Line of the Neck.—

From above downwards: Hyoid bone, thyro-hyoid membrane, thyroid cartilage, crico-thyroid membrane, cricoid cartilage, trachea—of which the second, third, and fourth rings are covered by the isthmus of the thyroid gland.

Hyoid Bone.—Can easily be felt when grasped from side to side.

Thyro-Hyoid Membrane.—Behind it is the lower part of the epiglottis. It is pierced on either side by the superior laryngeal nerve and the laryngeal branch of the superior thyroid artery.

Thyroid Cartilage.—The projection of its upper border, or *pomum Adami*, and the notch which it presents, are relatively little marked in the female, and in the male before puberty. The upper part of the lateral lobes of the thyroid gland can be felt, especially when enlarged, on either side of the cartilage. The gland moves up and down with the cartilage in deglutition.

Crico-Thyroid Membrane.—Is crossed by the small artery of the same name, a branch of the superior thyroid. In laryngotomy, the membrane is first exposed by a vertical incision, and then divided transversely close to the cricoid cartilage—that is, as far as possible from the vocal cords.

Cricoid Cartilage.—Is the surgeon's principal guide in tracheotomy. Behind it the pharynx narrows into the commencement of the œsophagus. Foreign bodies frequently lodge at this point.

The Trachea.—Recedes from the surface as it descends. Unless the low division be specially indicated, the canal had better be opened as high as possible. The isthmus of the thyroid gland (which crosses the second, third, and fourth rings of the trachea) can be either drawn down or divided; or the cricoid cartilage, with the two or three first rings of the trachea, may be divided (laryngo-tracheotomy).

The Inferior Thyroid Veins.—Are necessarily distended when tracheotomy is required. They should be avoided as far as possible, and any abundant hæmorrhage should be stopped before the trachea is opened. The left innominate vein rises somewhat dangerously high in front of the lower part of the trachea. In front of the trachea there is sometimes

a small artery—the thyroidea ima. In children, the thymus gland may rise a little above the sternum.

Sterno-Mastoid Muscle.—Stands out in bold relief when the face is turned towards the opposite side. When undissected, it curves forwards as far as the angle of the jaw, and covers nearly the whole of the common, external, and internal carotid arteries. It is crossed by the external jugular vein, which passes down from the angle of the jaw to near the middle of the clavicle. The anterior jugular vein lies in front of its anterior border.

Common Carotid Artery.—Extends from behind the sterno-clavicular articulation to the upper border of the thyroid cartilage, running along a line drawn from the articulation to a point midway between the angle of the jaw to the mastoid process. It is deep at its origin, and relatively superficial at its termination. The internal jugular vein lies on its outer side; the pneumo-gastric nerve lies between and behind the two vessels; the cord of the sympathetic lies behind the sheath of the artery; the descending noni nerve crosses the sheath anteriorly. The artery can best be compressed against the prominent anterior tubercle of the transverse process of the sixth cervical vertebra, called the carotid tubercle, or tubercle of Chassaignac. The artery is crossed at about the level of the cricoid.

cartilage by the anterior belly of the omo-hyoid muscle.

The Stylo-Hyoid and Posterior Belly of the Digastric.—Run obliquely downwards and forwards from the mastoid process to the hyoid bone. Beneath them passes the whole of the neuro-vascular bundle of the upper part of the neck.

The hypoglossal nerve runs along their lower edge, and marks the point where the external carotid artery is usually tied.

Above and in front of these muscles lies the superficial portion of the submaxillary gland.

Beneath the submaxillary gland, in the angle between the two bellies of the digastric, is the anterior part of the hypoglossal nerve, just before it disappears beneath the mylo-hyoid. The nerve and the two bellies of the muscle bound a small triangular space, of which the floor is formed by the hyo-glossus. The *lingual artery* crosses this space beneath the hyo-glossus muscle.

The *facial artery* grooves the upper and back part of the submaxillary gland, and then crosses the lower jaw in front of the masseter.

Between the sternal and clavicular heads of the sterno-mastoid lie the common carotid artery internally, and the internal jugular vein externally.

The vein, at this level, is clearly external to the artery on the right side of the neck, while, on the left side, it approaches and sometimes crosses it. Between and behind the two vessels is the pneumogastric nerve. The phrenic nerve lies external to the vein, in front of the scalenus anticus.

Between the two sterno-mastoids, at the lower part of the neck, is the “fonticulus gutturis,” which rises and sinks in distressed breathing.

The sterno-clavicular articulation marks the commencement of the innominate vein, and, on the right side, the division of the innominate artery.

The Supra-Clavicular Fossa.— Is crossed at its lower and inner part by the posterior belly of the omo-hyoid. Below, and then externally to this, it is crossed more or less horizontally, and at a somewhat variable level, by the *supra-scapular* and *transversalis colli* vessels; so that, in the ligature of the subclavian artery, the knife should be used with much care after the platysma and deep fascia have been divided.

The Triangle formed by the Scaleni Muscles corresponds pretty nearly to the outer border of the sterno-mastoid. Its base is formed by the first rib. Upon this rests the subclavian artery,

which can here be controlled by pressure downwards and inwards upon the bone. Above the artery are the cords of the brachial plexus. The subclavian vein lies below and in front of the artery, in front of the scalenus anticus.

The Lung.—Rises half an inch or an inch above the clavicle, and its apex can be examined by auscultation and percussion through the soft parts of the supra-clavicular fossa.

THORAX AND BACK.

Sternum.—Behind the first piece of the bone we find the *left innominate vein*, behind which are the *innominate, left common carotid, and left subclavian arteries*, the *trachea*, and the *œsophagus*. Below the left innominate vein comes the *arch of the aorta*, the highest part of which lies an inch below the upper border of the sternum.

The *trachea divides* into the two bronchi opposite the articulation between the two first pieces of the sternum, below and behind the arch of the aorta.

The *innominate artery* runs along a line drawn from the middle of the above articulation to behind the right sterno-clavicular joint.

The *internal mammary arteries* run behind the costal cartilages half an inch from either side of the sternum.

The top of the sternum corresponds to the second dorsal vertebra; its lower extremity corresponds to the tenth.

Ribs.—The *second rib* corresponds to the articulation between the first and second pieces of the sternum; the *fifth*, to the lower border of the pectoralis major; the *sixth*, to the highest digitation

of the serratus magnus usually visible in the axilla: the *two last* ribs can always be felt just external to the erector spinæ.

The *nipple* in the male lies in the fourth intercostal space, about four inches from the middle of the sternum.

Paracentesis pericardii is performed in the fourth or fifth intercostal space, just to the left of the sternum. *Paracentesis thoracis* is performed in the fifth or sixth intercostal space, a little above and in front of the lower angle of the scapula.

The *first, or ascending, portion of the arch of the aorta* commences behind the sternum, close to the lower border of the third left costal cartilage, and passes upwards and to the right behind the inner extremity of the second intercostal space to the upper border of the second costal cartilage of the right side, close to the sternum. The superior vena cava lies to its right, behind the inner extremity of the two first intercostal spaces.

Heart.—Its *base* lies behind the lower border of the second costal cartilages, and extends an inch to the left side and half an inch to the right side of the sternum. Its *apex* lies in the fifth intercostal space, two inches below and one to the inner side of the nipple. The lower part of its right border (some-

times called the *lower border*) runs to the right from the apex to the lower part of the right border of the gladiolus; it rests upon the cordiform tendon of the diaphragm. This border cannot be made out by percussion, on account of the subjacent liver. The upper part of the *right border* (sometimes called the right border) runs from the gladiolus to the right extremity of the base. It is convex to the right, and nearly coincides with the right border of the sternum. The left border runs from the apex to the left extremity of the base, being somewhat convex to the left, but just escaping the left nipple.

Valves of the Heart (*after Holden*).—"The aortic valves lie behind the third intercostal space, close to the left side of the sternum. The pulmonary valves lie in front of the aortic, behind the junction of the third rib, on the left side, with the sternum. The tricuspid valves lie behind the middle of the sternum, about the level of the fourth costal cartilage. The mitral valves (the deepest of all) lie behind the third intercostal space, about one inch to the left of the sternum."

Lungs.—Their *apices* rise behind the inner extremity of the clavicle and sterno-mastoid as much as an inch or an inch and a half above the first rib. Their *anterior borders* meet in the middle line behind

the sternum between the levels of the second and fourth costal cartilages. Inferiorly, the anterior *border of the right lung* follows the line of the sixth costal cartilage, while *that of the left* is notched to expose the apex and lower part of the anterior surface of the heart. Laterally, the lung usually descends as low as the *eighth rib*; posteriorly, as low as the *tenth*. In very deep inspirations the lung descends an inch and a half lower. The *line of reflexion of the pleura* from the chest wall on to the diaphragm runs along the costal cartilages from the lower extremity of the gladiolus to the lower border of the last rib, the pleura lining the inner surface of the latter.

The Vertebral Spines.—Can be felt from the sixth cervical downwards, the spine of the seventh cervical vertebra being the most prominent (V. prominens). The upper cervical spines, which lie in front of the ligamentum nuchæ, recede too much from the surface to be perceptible to the finger, except, possibly, the bifid extremity of the axis. The dorsal spines lie in the median furrow caused by the projection of the *erectores spinæ*. They do not lie on a level with corresponding rib and corresponding vertebral body; each lies on a level with the head of the rib and the body of the vertebra below. This is due to the obliquity of the dorsal spinous processes. The two lower dorsal spinous processes are less

oblique, and tally pretty accurately with the heads of the corresponding ribs.

Correspondences of the Principal Spines, mainly according to Holden :—

Dorsal Spines.—3rd. Bifurcation of trachea; aorta reaches spine. 4th. End of aortic arch. 5th. Upper level of heart. 8th. Lower level of heart; central tendon of diaphragm. 9th. Œsophagus and vena cava perforate diaphragm, and former opens into stomach; upper extremity of spleen. 10th. Upper limit, posteriorly, of convex surface of liver. 11th. Lower extremity of spleen. 12th. Limit of pleura behind; aorta perforates diaphragm.

Lumbar Spines.—1st. Renal arteries; pelvis of kidney. 2nd. Superior mesenteric artery crosses intestine, and mesentery begins; receptaculum chili; termination of spinal cord. 3rd. Umbilicus. 4th. Division of aorta; highest part of crest of ilium.

Scapula.—Covers the ribs from the third to the seventh. The root of the spine is marked by a slight dimpling of the skin. It lies on a level with the third dorsal spine.

SURGICAL ANATOMY.

PARTS CONCERNED in INGUINAL HERNIA—1st T.

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Form the inguinal & scrotal regions. From the latter are derived the superficial coverings of large hernie, which superficial coverings are the same as those of the cord & testis. The former comprises the parts more directly concerned in the occurrence of the protrusion, and in the surgical operations thereby required.

SCROTAL REGION — Vide "Coverings of Cord & Testis."

INGUINAL REGION — Bounded by Poupart's ligament, median line, horizontal line through anterior superior spine of ilium. Presents for examination the following strata, between which the inguinal canal is comprised.

Skin — Thin, freely movable, depressed over Poupart's ligament.

Superficial Fascia — Continuous with that of thigh, scrotum (dartos) & perineum. Divided into superficial & deep layers by the superficial vessels & nerves.

SUPERFICIAL LAYER — Thick, areolar, & more or less distended with fat. Passes over Poupart's ligament without adhering to it.

DEEP LAYER — Thin, membranous, contains no fat; adheres to Poupart's ligament.

SUPERFICIAL VESSELS & NERVES — Are :

Arteries — Superficial epigastric, superficial circumflex iliac, superficial external pudic.

Veins — Corresponding; open into internal saphenous.

Lymphatics — Converge towards the

Superior or Abdominal set of Inguinal Lymphatic Glands — Three or four, small, obliquely disposed along Poupart's ligament; receive lymphatics of penis, scrotum, perineum, lower part of abdomen & buttock. c 1

Nerves — Ilio-inguinal, & hypogastric branch of ilio-hypogastric.

Aponeurosis of External Oblique — Its fibres are oblique downwards & inwards, and form in succession Poupart's ligament, Gimbernat's ligament, Outer or Inferior pillar of external abdominal ring, Inner or Superior pillar, Superficial part of Linea Alba by decussating with their fellows, and perhaps also,

after devascularising, the *Triangular ligament* & the *Intercolumnar fibres of opposite side* (Vide Abdominal Aponeuroses). Continuous with this stratum of fibres is the *Intercolumnar or external spermatic fascia*, thin, closely adherent to margin of external abdominal ring, and prolonged downwards into a tubular process around cord and testis.

Lower Part of Internal Oblique - Thin & pale. Its fibres, which arise from outer half of Poupart's ligament, pass *inwards over spermatic cord (or round ligament)*, and then curve *downwards behind it* & behind external abdominal ring & Gimbernat's ligament, covering inner two-thirds of Hesselbach's triangle and forming part of conjoined tendon of internal oblique & transversalis, and, becoming tendinous, are inserted over the extent of about half an inch into crest of pubes in front of rectus and into ilio-pectineal line behind Gimbernat's ligament.

THE CREMASTER MUSCLE - (Vide "Muscles of the Abdomen" & "Coverings of the Testicle") is connected with lowest fibres of internal oblique, and occasionally also with some of the lowest fibres of transversalis.

Lower Part of Transversalis - Also thin & pale. Its fibres, which arise from outer third of Poupart's ligament, take the same course as preceding, and, also becoming tendinous, are inserted with them into crest of pubes and ilio-pectineal line to the extent of about an inch, completing conjoined tendon.

Fascia Transversalis - Part of the general layer of fascia which lines the abdominal & pelvic cavities. In the inguinal region it is thick and dense, and presents the following points of interest :-

AT CIRCUMFERENCE OF INTERNAL ABDOMINAL RING - It is prolonged into a tubular process of membranous, the *infundibuliform fascia*, which descends round the cord & testis, forming the *fascia propria* round the latter.

AT LOWER PART OF REGION - It is, -

In Front of Femoral Vessels - First thickened into an oblique band adherent to Poupart's ligament & termed the *deep crural arch*, and then continued downwards beneath Poupart's ligament in front of the vessels to form outer wall of femoral sheath.

Externally to Femoral Vessels - Attached to outer part of Poupart's ligament, and continuous with fascia ilioaca.

Internally to Femoral Vessels - Attached to crest of pubes & ilio-pectineal line behind conjoined tendon & Gimbernat's ligament.

That part of the fascia transversalis which lies above Poupart's ligament between outer border of rectus muscle & epigastric artery (Hesselbach's triangle) is interesting as being the part which forms a covering to direct inguinal hernia. Forms a bed in which the epigastric artery passes upwards & inwards along lower & inner boundaries of internal abdominal ring; is continued into a loose sheath round the cord.

Peritoneum - Presents, before the superficial stratum of the abdominal wall have been dissected, the two *Inguinal Fosse, internal & external*, which fossae correspond respectively to the external & internal abdominal rings, and are separated by an oblique crescentic fold of variable width & prominences, formed by the epigastric & obliterated hypogastric arteries

PARTS CONCERNED in INGUINAL HERNIA—2nd T.

INGUINAL OR SPERMATIC CANAL

Is an oblique passage $1\frac{1}{2}$ or 2 inches long situated a little above, and parallel to, inner half of Poupart's ligament. It gives passage to the spermatic cord or round ligament, and presents for examination its two openings or rings, and its boundaries or walls.

External Abdominal Ring - Triangular & oblique downwards & inwards, about 1 inch long & $\frac{1}{2}$ inch wide in male but rather smaller in female, bounded later-

ally by external & internal pillars, above by the intercolumnar fibres, below by the crest of the pubes. Gives off from its margin the intercolumnar or external spermatic fascia, which is prolonged into a tubular process around cord & testis (V. Abdominal Aponeuroses).

Internal Abdominal Ring - A tubular opening in the fascia transversalis formed by the prolongation of this fascia round the cord & testis (infundibuliform fascia, fascia propria), oval with large diameter directed downwards & outwards; situated midway between anterior superior spine of ilium & spine of pubes about $\frac{1}{2}$ an inch above Poupart's ligament; bounded above & externally by the lower arched fibres of internal oblique & transversalis, below & internally by epigastric vessels.

Boundaries or Walls - Formed by:

IN FRONT - Aponeurosis of *external oblique* along whole length; lowest fibres of *internal oblique* along outer third.

BEHIND - *Fascia transversalis* along whole length; *conjoined tendon* of internal oblique & transversalis, & also *triangular ligament* along inner third.

ABOVE - *Arched fibres of internal oblique & transversalis.*

BELOW - *Poupart's ligament* blended posteriorly with fascia transversalis.

SURGICAL ANATOMY of INGUINAL HERNIA.

Principal points of interest are the coverings of the hernia, and the relations of the neck of the sac & of the seat of stricture. — For the rest see “Inguinal Hernia” among Tablets on Surgery.

COVERINGS — Differ in the oblique & direct forms, and are slightly modified also in the congenital & infantile varieties of the former, and in the external & internal varieties of the latter. They are as follows :—

OBLIQUE INGUINAL HERNIA Of the Adult

FROM WITHIN OUTWARDS:

Peritoneum, subserous areolar tissue, infundibuliform fascia, cremasteric fascia, intercolumnar fascia, superficial fascia, skin.

FROM WITHOUT INWARDS:

Skin, superficial fascia, intercolumnar fascia, cremasteric fascia, infundibuliform fascia, subserous areolar tissue, peritoneum.

Congenital Variety — Descends directly into tunica vaginalis through pouch of peritoneum which accompanies cord & testis into scrotum, and which has abnormally remained *unclosed*. Its coverings are the same as those of testicle: — *Skin, dartos, intercolumnar fascia, cremasteric fascia, fascia propria, tunica vaginalis reflexa.*

Infantile Variety — Descends into the still patent upper part of the *imperfectly closed* pouch of peritoneum, and becomes more or less completely invested, especially in front, by the posterior part of the tunica vaginalis reflexa. Its coverings are *the same* as those of foregoing variety

DIRECT INGUINAL HERNIA

Internal or Common Variety – (Protrudes through inner part of Hesselbach's triangle, on inner side of obliterated hypogastric artery).

FROM WITHIN OUTWARDS:

Peritoneum, subserous areolar tissue, fascia transversalis (the general f. tr., not the infundibuliform process) *conjoined tendon* (or not, since it is frequently ruptured instead of being pushed forwards) *intercolumnar fascia, superficial fascia, skin.*

FROM WITHOUT INWARDS:

Skin, superficial fascia, intercolumnar fascia, conjoined tendon (or not), *fascia transversalis, subserous areolar tissue peritonæum.*

External Variety – (Protrudes through outer part of Hesselbach's triangle, on outer side of obliterated hypogastric artery, & externally to the conjoined tendon) – This exceptional form of inguinal hernia, passes through a considerable portion of the inguinal canal, and greatly resembles the oblique hernia both by presenting a certain degree of obliquity and by having very nearly the same coverings; the covering derived from the cremasteric fascia is alone rather less complete.

RELATIONS OF NECK OF SAC & SEAT OF STRICTURE –

The neck of the sac lies

IN OBLIQUE INGUINAL HERNIA – *On outer side of epigastric artery and in front of spermatic cord*, the elements of which may, however, be more or less scattered round the neck of the sac.

IN DIRECT INGUINAL HERNIA – *On inner side of epigastric artery, in front & slightly on inner side of spermatic cord.*

On account of the uncertainty of the diagnosis between the oblique & direct hernia it is an accepted rule in surgery to divide a deep seated stricturo *directly upwards from middle of upper margin of constricting ring*, that is to say in the direction of the epigastric vessels.

SCARPA'S TRIANGLE—1st Tablet.

Is a broad triangular depression

Situated at upper, inner, & front part of thigh;

Bounded by Poupart's ligament, sartorius & adductor longus;

Continued downwards & inwards into a superficial furrow, which marks position of femoral artery in Hunter's canal.

Its floor is formed from without inwards by iliacus, psoas, pectineus, & small part of adductor brevis. It contains femoral vessels & anterior crural nerve, and the

PARTS CONCERNED IN FEMORAL HERNIA — These parts are :—

SKIN — Thin, freely movable, more or less studded with hairs at upper & inner part.

SUPERFICIAL FASCIA — Divided into two layers by superficial vessels & nerves & inguinal lymphatic glands.

SUPERFICIAL LAYER — Thick, areolar, contains a large amount of fat, and is continuous with subcutaneous tissue of surrounding regions; is rather thinner & less loaded with fat towards lower part of triangle.

DEEP LAYER — Thin & membranous. Adherent superiorly to Poupart's ligament. Stretches over saphenous opening under the name of "*cruriiform fascia*," which fascia is perforated by internal saphenous vein & by numerous smaller blood & lymphatic vessels, and is attached firmly to outer margin of the opening, & slightly to the inner margin.

Superficial Vessels & Nerves and Lymphatic Glands — Are the :

Internal saphenous vein;

Superficial epigastric, superficial circumflex iliac, superficial external pudic arteries with the corresponding veins, which latter open into internal saphenous near its termination;

Lymphatic glands - Form two groups. Those of the

Superior or abdominal group - Are the smaller, and are placed transversely near Poupart's ligament; - they receive lymphatics of penis, scrotum, perineum, lower part of abdomen & buttock; - those of the

Inferior or femoral group - Are the larger, and are vertically disposed round upper part of saphenous vein; - they receive the lymphatics of lower limb.

DEEP FASCIA OF FASCIA LATA - Dens, fibrous. Presents the saphenous opening, for easier description of which it is usually divided into two portions, the iliac & the pubic.

ILIO PORTION - The thicker. Attached to crest of ilium, Poupart's ligament & spine of pubes. Is reflected downwards & outwards from this latter point, first bounding the superior angle, or *superior cornu* of the opening, then forming its outer margin. This outer margin is the *falciform process of Burns*; its upper part is often called *Hey's femoral ligament*. Superiorly this margin overlies the sheath of the femoral vessels. Inferiorly it becomes continuous with pubic portion of the fascia lata by a well defined curved border, which forms the inferior angle, or *inferior cornu* of the opening.

PUBIC PORTION - Much thinner. Is attached to pubic arch at upper and inner part of thigh, and is continuous with iliac portion opposite lower cornu of saphenous opening. From this point it is prolonged upwards & outwards behind femoral sheath & in front of pectineus, and becomes attached to ilio-pectineal line.

Saphenous Opening - Is formed therefore by the slitting of the fascia lata & by the folding of the two sides of the slit one over the other. It is oval in shape, broad below, narrow above, $1\frac{1}{2}$ inches long, $\frac{1}{2}$ an inch wide. Its

OUTER BOUNDARY & ITS SUPERIOR ANGLE OR CORNU - Which are prominent & well defined, are formed by iliac portion of the fascia lata (falciform process & femoral ligament), which portion, as already stated, passes upwards & inwards in front of the femoral sheath, and becomes attached to Poupart's ligament & spine of pubes. - Its

INNER BOUNDARY - Depressed & less clearly defined, is formed by the pubic portion of the fascia lata, which portion, as already stated, passes upwards & outwards behind femoral sheath & in front of pectineus, and becomes attached to the ilio-pectineal line. - Its

INFERIOR ANGLE OR CORNU - Is formed by the junction of the iliac & pubic portions of the fascia lata just below opening of internal saphenous vein into the femoral

FEMORAL SHEATH - Vide next Tablet.

SCARPA'S TRIANGLE—2nd Tablet.

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FEMORAL

SHEATH — Is a thin tube of fascia divided by two delicate septa into three compartments, of which compartments the outermost contains the femoral artery & the crural branch of the genito-crural nerve, the middle one the femoral vein, and the innermost, which is called the femoral canal, some fat & a lymphatic gland.

It is expanded superiorly, where it is continuous beneath Poupart's ligament with the fascie of the abdomen, the fascia transversalis & the fascia iliaca passing down to form it, the former in front of, and the latter behind, the femoral vessels.

It is narrow inferiorly, and blends about two inches below Poupart's ligament with the common areolar sheath of the femoral vessels.

Anteriorly it is covered by the iliac portion of the fascia lata (falciform process & femoral ligament), Poupart's ligament, the deep crural arch, and, opposite the saphenous opening, by the cribriform fascia.

Posteriorly it rests upon the pubic portion of the fascia lata & the pectineus muscle.

Its outer wall is vertical, lies in immediate contact with the artery, and is perforated by the crural branch of the genito-crural nerve.

Its inner wall is oblique downwards & outwards from base of Gimbernat's ligament to inner surface of femoral vein. It is pierced superiorly, where it corresponds to the femoral canal, by numerous lymphatic vessels, and, inferiorly, or below the femoral canal, by the internal saphenous vein.

FEMORAL CANAL

— Is the innermost compartment of the femoral sheath. Or rather it is the narrow interval comprised, at the upper part of the femoral sheath, between the inner wall of the sheath & the femoral vein; for it can hardly be said to exist as a distinct canal unless the wall of the sheath has been separated from the vein either by dissection or by the pressure of a hernia.

It contains a little fat & a lymphatic gland. It extends from the femoral ring to the upper part of saphenous opening, and measures from $\frac{1}{4}$ to $\frac{1}{2}$ an inch in length.

It presents four walls & two openings.

ANTERIOR WALL — Formed by the fascia transversalis, and supported by Poupart's liga-

ment, deep crural arch, & iliac portion of fascia lata (falciform process & femoral ligament):

POSTERIOR WALL - Formed by the fascia iliaca; rests upon pubic portion of fascia lata & pectineus muscle;

INNER WALL - Formed by junction of fasciae transversalis & iliaca;

OUTER WALL - Formed by the thin septum on inner side of femoral vein;

SUPERIOR OPENING, OR FEMORAL RING - Vide below.

INFERIOR, OR SAPHENOUS OPENING - Vide foregoing Tablet.

Femoral Ring - Is the opening of the femoral canal into the abdomen. - Its boundaries are: -

IN FRONT - Poupert's ligament and the deep crural arch;

BEHIND - Pubes covered by pectineus muscle, & pubic portion of fascia lata;

INTERNALLY - Gimbernat's ligament with the triangular ligament, the conjoined tendon, & the deep crural arch.

EXTERNALLY - Femoral vein & the thin septum between it & crural canal.

Its relations are as follows:

Femoral vein, on outer side;

Epigastric artery, crossing upper & outer angle;

Spermatic cord or round ligament, & *pubic branch of epigastric* above & in front;

Obturator artery, on inner side, in those rare cases in which the artery presents the double abnormality of arising from the epigastric artery, and of arising from that artery at some distance from its root; - the obturator artery then passes first inwards above the ring, and then downwards into the pelvis behind Gimbernat's ligament.

It is nearly eireular, about $\frac{1}{2}$ an inch wide in the male, a little wider in the female, and is closed by the

SEPTUM CRURALE (J. Cloquet) - A more or less condensed layer of supertoneal areolar tissue adherent to margins of femoral ring, and perforated by numerous apertures for lymphatics. Its upper surface is concave, and separated from the peritoneum by a less condensed layer of the same tissue and sometimes by a lymphatic gland; its under surface is convex & turned towards the femoral canal.

The femoral canal & both its openings are constructed by extension & eversion, and relaxed by flexion & inversion of the thigh.

COVERINGS OF FEMORAL HERNIA - ARE: -

FROM WITHIN OUTWARDS: - *Peritoneum, subperitoneal areolar tissue* (a portion of which, thickened & caused to assume a membranous appearance by the pressure of the hernia, was described by Sir A. Cooper under the name of *fascia propria*), *septum crurale*, *crural sheath*, *criciform fascia*, *superficial fascia*, *skin*.

FROM WITHOUT INWARDS: - *Skin*, *superficial fascia*, *criciform fascia*, *crural sheath*, *septum crurale*, *subperitoneal areolar tissue*, *peritoneum*.

The deep seated stricture is to be divided upwards & inwards, in which direction no important vessel is likely to be met with.

THE ISCHIO-RECTAL REGION.

Corresponds to the portion of outlet of pelvis situated behind a line drawn from front part of one tuber ischii to that of the other. It is bounded in front by above mentioned line; its apex is at point of coccyx; its sides are formed by tuberosities of ischium, great sacro-sciatic

ligaments & great glutei muscles. It contains terminal portion of rectum surrounded by levatores ani and the internal & external sphincters, and on each side of which is the ischio-rectal fossa.

It is triangular in form and depressed centrally towards anus, round which aperture the integument is thrown into numerous folds, and becomes continuous with mucous membrane of intestine.

The skin is dark, but thicker & less movable than on perinaeum proper, and contains a few hair-follicles.

The subcutaneous areolar tissue or superficial fascia hardly exists in centre of region, or over sphincter ani, which musculo is closely adherent to integument; but it is abundant laterally, where it is loaded with a large amount of fat, and where it dips into and fills the ischio-rectal fossa.

ISCHIO-RECTAL FOSSA

Is a large excavation which sinks deeply into pelvis on either side of rectum, and which is filled with a considerable amount of loose fatty areolar tissue.

It is wide & triangular at its

Base, - Which corresponds to integument, but it is flattened from side to side and diminished in size superiorly. - Its

Inner Wall - Is oblique downwards & inwards and formed by under surface of levator ani & by sphincter, which muscles are covered by anal fascia.

Outer Wall - Is vertical, and is formed by obturator internus covered by obturator fascia; it presents the pudic vessels & nerve enclosed in a sheath of fascia.

It is bounded :

Above - By junction of anal & obturator fasciæ.

In Front - By junction of the same fasciæ superiorly, and, inferiorly, by junction of the superficial & deep perineal fasciæ behind transversus perinei.

Behind - By sacro-sciatic ligaments, coccygens & the gluteus maximus.

The vessels & nerves it contains are the :

Inferior hæmorrhoidal, in the centre;

Pudic, in the outer wall;

Superficial perineal, in front;

A branch of 4th sacral nerve, and branches of sciatic artery & small sciatic nerve, behind; the branches of the latter nerve winding round lower border of gluteus maximus.

Above levator ani is the recto-vesical layer of the pelvic fascia (Vide Pelvic F.)

THE MALE PERINÆUM.

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Consists of the structures which close outlet of pelvis anteriorly to line drawn from front part of one tuber ischii to that of the other. It is triangular in form, and is bounded laterally by rami of pubes & ischia and posteriorly by above mentioned line. The width of its base (rather the smallest side of the triangle) is usually about $2\frac{1}{2}$ inches in the male adult, but it is sometimes considerably reduced; the operation of lateral lithotomy is then greatly impeded.

The part is convex in middle line & slightly depressed laterally, and presents the following layers :

Skin - Thin, dark, freely movable, marked by a prominent median *raphé*, studded with thin crisp hairs, and provided with numerous sebaceous follicles.

Superficial Fascia - Divided into two layers.

SUPERFICIAL LAYER - Thick, areolar, contains a large amount of fat, and is continuous with subcutaneous tissue of surrounding regions.

DEEP LAYER - Thin & aponeurotic; lies in close contact with the muscles.

On either side it is attached to rami of pubes & ischia externally to crura penis;

Behind it is connected to central tendinous point of perineum; and is prolonged beneath sphincter ani, becoming continuous behind transversus perinei & in front of rectum with inferior layer of deep perineal fascia;

In front it is unattached, & continuous with dartos;

Superiorly it gives off a median septum, which is rather deficient in front but pretty well marked behind.

It binds down the superficial structures, and bounds inferiorly, and also, through its attachments, laterally & behind, a space, in which if urine be effused, this fluid will be directed forwards towards the scrotum, and the lower part of abdomen, and prevented from passing backwards towards anus, or outwards towards thighs. This layer is sometimes called the *superficial perineal fascia*.

Superficial Genito-Urinary Muscles - Are the -

ERECTOR PENIS - Covering the crus :

ACCELERATOR URETHRE OR EJACULATOR SEMINIS - Spreading out upon bulb of urethra ;
 TRANSVERSUS PERINÆI - Separating perineum proper from ischio-rectal region.

These muscles bound a triangular area, which is crossed superficially by the superficial perineal vessels & nerve, behind which area passes transversely inwards the transverse perineal artery, and through which area can be seen deeply the superficial layer of the deep perineal fascia. In lateral lithotomy the knife is carried backwards & outwards through inner & back part of this area on left side.

Inferior Layer of Deep Perineal Fascia, or Triangular Ligament of Urethra - Vide below.
Membranous Portion of Urethra, Compressor Urethræ, & Deep Transversus Perinæi, Pudic Vessels & N., Vessels & N. of Bulb, Cowper's Glands & their Ducts - Vide these parts.
Superior Layer of Deep Perineal Fascia -

The deep perineal fascia is a complex structure triangular in form, which supports the urethra, and closes anterior part of outlet of pelvis.

On either side it is attached to rami of pubes & ischia internally to crura penis ;

Behind it is connected to central tendinous point of perineum, and is continuous both with thin fascia on under surface of levator ani, and, behind transversus perinæi, with deep layer of superficial fascia of perineum ;

In front it is attached to pubic arch & sub-pubic ligament.

It consists of two aponeurotic layers which are separated in the centre, but united laterally & behind ; of these two layers the

ANTERIOR, INFERIOR, OR SUPERFICIAL LAYER - The thickest, is continued downwards & forwards upon anterior part of membranous portion of urethra, and is lost upon the bulb. This layer is perforated by the *urethra* about an inch below symphysis pubis, by *dorsal vein of penis* in front of urethra, & by *pudic vessels & nerve* on either side of the vein ; it is the only layer that can properly be called the triangular ligament of the urethra, though the term

is sometimes applied to both layers taken together.

POSTERIOR, SUPERIOR, OR DEEP LAYER - Thinner. Is continued upwards & backwards round posterior part of membranous portion of urethra, and becomes continuous with pelvic fascia.

Between these two layers are comprised the parts above mentioned, viz., *membranous portion of urethra with compressor urethræ & deep transversus perinæi muscles, pudic vessels & nerve with vessels & nerve of bulb, Cowper's glands & their ducts.*

Above these parts are found in centre of perineum the

Prostate Gland & Neck of Bladder, - and laterally the

Anterior Part of Levator Ani & of Pelvic Fascia - The latter fascia is continued posteriorly upon posterior part of levator ani, upon rectum & between it & bladder, and belongs as much to ischio-rectal region as to the perineal.

MUSCLES OF THE MALE PERINÆUM.

Sphincter Ani.—Tip & back of coccyx and superficial fascia in front of it.

Central tendinous point of perinæum blending with accelerator urinæ, transversus perinæi & levator ani.—S. by inferior hæmorrhoidal branch of pudic, & by anterior division of 4th sacral nerve.

Levator Ani.—Back of pubes close to symphysis, spine of ischium, and, between these two points, from a white band or thickening of the pelvic fascia which marks point of division of the latter fascia into obturator & recto-vesical layers.

Side & apex of coccyx, median raphé between coccyx and anus, side of lower part of rectum blending with sphincter ani, and decussates with its fellow in front of rectum and below & behind the prostate, forming the so-called levator prostatae, which latter fasciculus is sometimes separated from the remainder of the muscle by a little areolar tissue.—S. by anterior division of 4th sacral nerve.

Coccygeus.—Spine of ischium & lesser sacro-sciatic ligament.

Side of coccyx and of lower piece of the sacrum.—S. by anterior divisions of 4th & 5th sacral nerves.

Internal Sphincter.—Is a thickened circular band of the unstripped muscular fibres of the intestine.

Accelerator Urinæ, Ejaculator Seminis, or Bulbo-Cavernous.—Central tendinous point of perinæum & median raphé in front of it.

Its posterior fibres are inserted into the triangular ligament; its middle fibres decussate above the bulb & corpus spongiosum, which they encircle; its anterior fibres are partly inserted into the corpus cavernosum, and partly joined above it in a tendinous expansion which covers dorsal vessels & nerves of penis.—S. by superficial perinæal nerve.

Erector Penis, or Ischio-Cavernous.—Inner aspect of tuberosity of ischium behind crus penis and pubic arch on either side, back part of under surface of the crus.

By a tendinous expansion into fore part of under & outer surfaces of crus penis.—S. by superficial perinæal nerve.

Transversus Perinæi.—Inner & fore part of tuberosity of ischium.

Central tendinous point of perinæum blending with its fellow, the accelerator urinæ, & sphincter ani.—S. by superficial perinæal nerve.

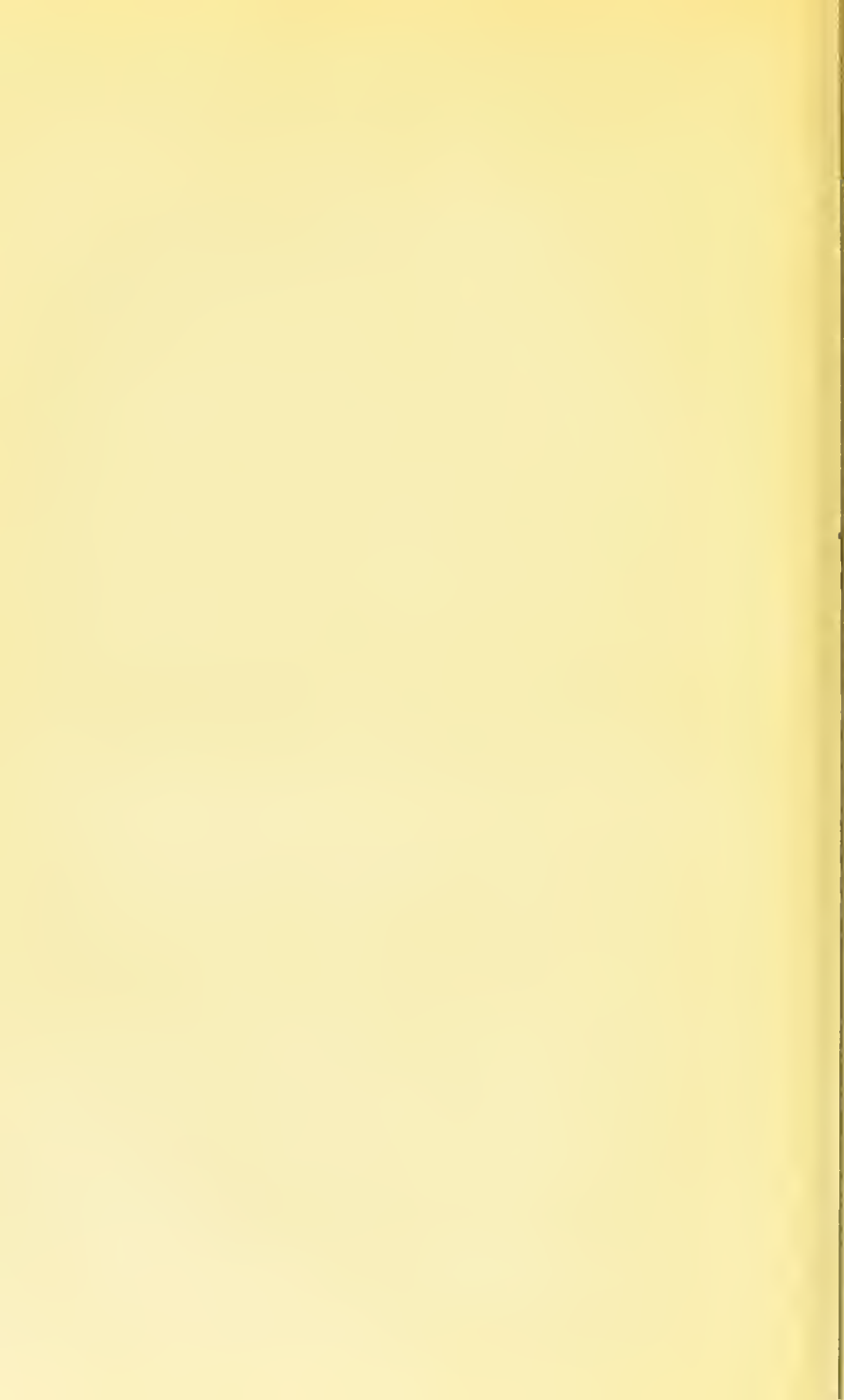
Compressor, or Constrictor Urethræ.—Upper part of public arch on either side of symphysis.

Its fibres surround membranous portion of the urethra, decussating above and below it.—S. by pudic nerve.

Deep Transversus Perinæi.—Is a thin fasciculus which may or may not be separated from posterior fibres of foregoing muscle. I decussates with its fellow behind the bulb, and covers Cowper's gland.

II.

OPERATIVE SURGERY.



GENERAL REMARKS ON LIGATURES AND AMPUTATIONS.

The following embody a few practical remarks, several of them the result of a good many years' observation in the teaching of operative surgery. A little indulgence is asked for in respect of any slight departures from usually accepted lines of thought:—

REMARKS ON LIGATURES.

It may be of use to divide the operation for the tying of an artery into : (1) the division of the skin and superficial fascia ; (2) the division of the deep fascia ; (3) the subsequent dissection ; (4) the cleaning of the artery ; (5) passing the ligature, and tying the knot.

(1.) The incision should be made, as a rule, *in the course of the artery* ; in some cases, however, *e.g.*, in the ligature of the subclavian artery and of the first part of the axillary, the incision is made to cross the course of the artery more or less obliquely. The incision should be *from two to four inches in length*, being shorter for a superficial artery than for one more deeply situated. The incision should be made *without tailing* ; to insure this, the knife should be held vertically when entered, and should again be brought to the vertical position as it is withdrawn. While making the incision the surgeon should bear in mind the situation of any important superficial vein or nerve, in order to avoid injuring the same, should it come under his knife. The incision should be *deepened till the deep fascia is thoroughly exposed*. *But the deep fascia should not be divided just yet* : it is desirable to verify through the undivided deep fascia the exact situation of such guide points as may be visible through it, *e.g.*, tendons of supinator longus and flexor carpi radialis in the ligature of the lower part of the radial artery ; then, if the incision is found not to have been made in exactly the right place, it can be shifted a little by slight traction on the skin. There is no shifting the incision through the deep fascia, when this has once been divided.

(2.) The deep fascia should be divided on the director *if the artery is immediately subjacent*, as in the case of the radial in its lower part ; the

director should not otherwise be used for dividing the deep fascia. It will soon be learnt by experience that, when used otherwise than for the division of layers of fascia sufficiently thin for them to be translucent, the director is by no means the safe instrument generally supposed.

(3.) The dissection which follows the division of the deep fascia (when the artery is not immediately subjacent to it) should aim mainly at distinctly making out the several successive guide-points. All structures met with should be separated along the whole length of the wound. The wound should be kept of the same depth and length throughout; it should not be allowed to become contracted or narrowed till the sheath of the artery is reached, and the vessel is clearly seen through it.

(4.) The moment the sheath is thoroughly exposed, and the vessel clearly seen, dissection along the length of the wound should cease. Only such portion of the sheath should be opened as is necessary for the convenient cleaning of the artery and for passing the aneurism needle and thread.

How an artery should be cleaned is better demonstrated than explained in words. But the result of this most delicate part of the operation should be that a portion of the artery, varying from an eighth to a quarter of an inch in length, be absolutely and completely bared without any disturbance whatsoever of any other element of the neuro-vascular bundle; the *venæ comites*, in particular, should in no way be turned out of the compartment of the sheath occupied by them.

(5.) The aneurism needle should be passed from the side of any important nerve or vein; it may be passed either armed or unarmed. Experience should be acquired in tying the reef-knot.

REMARKS ON AMPUTATIONS.

Position of the Operator.—Always stand, if it be not too inconvenient, ON THE RIGHT SIDE OF THE LIMB TO BE AMPUTATED, so as to be able to retract with your left hand the tissues which are to form the covering or flap; the words “if it be not too inconvenient” referring, for obvious reasons, to amputations of the *left thigh above its middle*, and of the *left arm above its upper third*. *In all amputations of right limbs stand on the right side of the body.*

Methods of Amputating.—From the point of view of the inexperienced operator, operating, it is hoped, on the dead body, methods of amputation may conveniently be divided, the author thinks, into those in which the covering is cut *from without inwards*, i.e., from the skin towards the deeper parts (circular, mixed flap & circular, flaps from without inwards), and those in which the covering (necessarily consisting of two flaps) is made *from within outwards*, or by *transfixion*.

The behaviour of the skin—of which, if he will but notice it, the student will become aware as soon as he has made his first incision—and the exteme importance of a good and ample skin covering, supply the basis of the proposed division.

The skin, when divided, retracts very considerably—more so, in the dead body at least, than do the muscles. When the covering is made from without inwards—and the muscles are divided, the superficial ones at the level to which the skin has retracted, and the deeper ones still higher up—this retraction of the skin is immaterial so far as the covering is concerned, provided the bone be divided as is recommended below. But when flaps are made by transfixion the frequent result, if it be not guarded against, is that the muscles, when the flaps are completed, are seen to stand out considerably beyond the skin.

An obvious conclusion is that the young surgeon, till he have acquired experience, should, as far as possible, adopt the safer course of making the covering from without inwards, *i.e.*, from the surface to the deeper parts.

Cutting Flaps by Transfixion.—E (see diagram below) being the point at which the knife is entered, the author's experience is that most operators cut too far downwards, and then, altering too suddenly the direction of the blade, try to cut too directly outwards (dotted line). Instead of thus cutting first downwards and then outwards, the operator should follow a somewhat elliptical line, such as the dark line in the diagram. It will be noticed that the dark line is made up of several short straight lines; these are intended to represent the several partial cuts made by the successive intrusts and withdrawals of the amputating knife, of which the elliptical curve is made up. The first intrust is made with the blade in the direction of the axis of the limb, the first withdrawal is made with the blade slightly inclined outwards, the second intrust is made with the blade a little more inclined, and so on. It is desirable that the knife should be sharp, and that the several intrusts and withdrawals should be good long sweeps of the knife, so that the cutting be effected with as little pressure as possible of the blade against the soft parts, consequently with as little tension as possible of the soft parts, or as little dragging as possible of the soft parts by the knife. It will be seen that if the soft parts are tensed or dragged upon when the knife cuts its way out, the skin, being stretched before being divided, will, when divided, immediately retract, and thus leave the muscles more or less uncovered. If there is any sign of its being tensed,

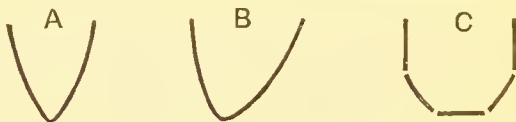


the skin should be drawn upwards, *i.e.*, towards the root of the limb, before it is divided.

The Width of Flaps.—During many years' experience as a teacher of operative surgery, the author has almost invariably noticed in beginners a tendency which requires to be carefully guarded against. It is the tendency when amputating by the two-flap method to make the first flap too narrow—that is to say, embracing less than the half circumference of the limb. The first flap being too narrow, the second flap is of a necessity markedly too wide, for what is taken off the first flap is tacked on to the second flap in addition to the share of soft parts which properly belongs to it.

The author would strongly advise the inexperienced operator who is going to perform an amputation by the two-flap method to first divide *à vue d'œil* the circumference of the limb into two halves (generally anterior and posterior), and, grasping the limb from behind with the left hand, to mark out with thumb and middle finger of that hand, while beginning the first flap, the two extremities of the diameter of the limb (generally the transverse diameter) from which the flaps are to hang. The sides of the first flap being demarcated by two downward incisions made from such points, the danger of making flaps of unequal width disappears.

The Shape of Flaps.—Beginners frequently make their flaps more or less lance-shaped, as in A, or, worse still, having begun their flap on one side by an oblique incision (as *a* in Fig. B), and finding that



it is getting too pointed below, they try to widen it on the other side, thus making it lopsided. The two lateral incisions which bound the flap at its base should be parallel to axis of the limb. Theoretically, a flap may be considered as bounded by five incisions, as in C, *i.e.*, two vertical incisions in the axis of the limb bounding its base and sides, a transverse incision across the limb bounding its apex, and two oblique curved incisions rounding off its angles. The beginner will find it to his advantage to fix his mind, while making a flap, mainly upon the vertical direction and proper position (for the position *see* above) of the incisions bounding the flap at its base and sides, and on the transverse direction of the incision bounding it at its apex. The angles of the flap will be sure to be rounded off satisfactorily.

Length of Flaps or other Covering.*—"In operating on

* Condensed from Erichsen's "Science and Art of Surgery."

the dead body it is evident that if two equal flaps, each half the diameter of the limb at the point at which the bone is divided, were cut, they would accurately meet and cover the bone; but such flaps in the living body would be totally inadequate, on account of the shrinking from the elasticity of the skin and the displacement from the contraction of the muscles. It is necessary to provide another half diameter of covering *at least*, and in some situations even this amount is barely sufficient. Let us suppose a limb is to be amputated, the antero-posterior diameter of which, at the point where the bone is to be sawn, is six inches, the necessary diameter and a half of covering could be obtained in the following ways amongst others:—(1) one long flap nine inches long; (2) two flaps, one six inches long and the other three; (3) two equal flaps four and a half inches long; (4) two equal flaps three inches long, and retraction of the muscles from the bone to such an extent as to provide an inch and a half of covering on each side; (5) a circular incision raising the skin and fat for three inches, and another circular cut through the muscles with retraction of the soft parts from the bone for one inch and a half. . . . In the lower third of the thigh the covering should be increased to two diameters to allow for the very excessive retraction of the long flexor muscles. In the amputation of the leg by the long calf flap, it is also necessary to provide very abundant covering to allow for the subsequent shrinking of the muscular tissue which forms the posterior flap."

Instead of attaching quite so much importance as above to the precise *preliminary* measurement of flaps, the author would suggest that it is enough, at least in operations on the dead body, that the operator, having determined *approximately* the point of intended division of the bone, should cut the flaps *approximately to suit*, and having cut them, verify by examination *à vue d'œil* BEFORE SAWING THE BONE, whether or not they are sufficient, and if they are not, clear and saw the bone a little higher up. The writer would strongly press the inexperienced operator to make it a point never to saw the bone before pausing to verify that the covering he has provided is sufficient.

Composition of Flaps or other Covering.*—"All surgeons are now agreed that too much muscle in a flap is an unmitigated evil. The objections to muscular flaps are that they are heavy, and consequently liable to be displaced; that, supposing any voluntary movement or involuntary jerking or twitching of the limb to occur, the surfaces of the flaps are moved upon each other, and primary union is thus prevented; that muscular flaps retract to a considerable extent after the operation, and continue to shrink for some time, thus causing a tendency to protrusion of the bone; and lastly that, as in the end the muscle completely wastes away, the idea that a muscular

* Condensed from Erichsen's "Science and Art of Surgery."

flap forms a better cushion than one composed of skin and subcutaneous fat is erroneous. None of these objections can be raised against a covering composed solely of the cutaneous and subcutaneous tissues. But, on the other hand, in very emaciated subjects such a covering is very thin, and is apt to suffer from the direct pressure of the bone against it, and consequently in such cases it is well to protect it by raising a certain amount of muscle with it. The object of the surgeon is, therefore, to save so much muscle that, after full retraction has taken place, it will still be level with the sawn end of the bone. In order to obtain this result, the proportions usually sufficient are to provide one diameter of covering composed of the skin and subcutaneous structures, and half a diameter of muscle, or more if the retraction is expected to be considerable, as in the lower part of the thigh. Skin flaps also, if very long, are apt to slough, as their vascular supply is somewhat limited, and this accident is especially likely to happen in old people. . . . In any patient, whether young or old, sloughing will almost certainly occur if the surgeon turns the edge of the knife towards the flap instead of keeping it directed to the part to be removed."

Retrospect: the Choice of Methods.*—"Three great eras may be recognised in the progress of methods of amputating:—

"I. Prior to the invention, or at least prior to the general introduction of the ligature and the tourniquet, the great barrier to all improvement in operating was the impossibility of checking hæmorrhage during an operation, and after its conclusion. Many surgeons would not amputate at all, others only through gangrenous parts; others, more bold, only at the confines of parts in which gangrene had been artificially induced by tight ligatures. With the exception of Celsus, who in one place recommends a flap to be dissected up, and the bone thus divided at a higher level, all were in too great a hurry to get the operation completed to think of flaps. Cut through all the parts at the same level with a red-hot knife, if you will, like Fabricius Hildanus; by a single blow with a chisel and mallet, like Scultetus; or by a crushing guillotine, like Purmanus; or by two butchers' chopping-knives fixed in heavy blocks of wood, one fixed, the other falling in a groove, like Botal; and then try to check the bleeding by tying a pig's bladder over the face of the stump, like Hans de Gersdorf; or tying it up in the inside of a hen newly killed; or by plunging it at once into boiling pitch. We are the less surprised to read of Celsus' description of a flap operation, when we remember that it is almost certain that Celsus *was* acquainted with the ligature as a means of checking hæmorrhage."

"II. A new era was ushered in when, about 1560, Ambrose Paré invented, or reintroduced, the ligature as a means of arresting hæmorrhage

* From Bell's "Operative Surgery."

but not for more than a century after this did the full benefit of his discovery begin to be felt, when the tourniquet was introduced by Morel at Besançon in 1674, and James Young of Plymouth in 1678, and improved by Petit in 1708-10. *Now* surgeons had time to look about them during an amputation, and to try to get a good covering for the bone, so that the stump might heal more rapidly and bear pressure better. Great improvements were rapidly made, and any history of these improvements would need to trace two great parallel lines, one the circular method, the other the flap operation."

"1. The old method in which the limb was lopped off by one sweep, all the tissues being divided at the same level, might be called the true circular. This, however, was soon improved—"

"*A.* By Cheselden and Petit, who invented the double circular incision, in which first the skin and fat were cut and retracted, and then the muscle and bone were divided as high as exposed."

"*B.* By Louis, who improved this by making the first incision include the muscles also, the bone alone being divided at the higher level."

"*C.* By Mynors of Birmingham, who dissected the skin back like the sleeve of a coat, and thus gained more covering."

"*D.* Then comes the great improvement of Alanson, who first cut through skin and fat, and allowing them to retract, next exposed the bone still farther up by cutting the muscles obliquely, so as to leave the cut end of the bone in the apex of a conical cavity."

"*E.* An easier mode, fulfilling the same indications, is found in the triple incision of Benjamin Bell of Edinburgh, who in 1772 taught that first the skin and fat should be divided and retracted, next the muscles, and lastly the bone."

"*F.* A slight improvement on *E*, made by Hey of Leeds, who advised that the posterior muscles of the limb should be divided at a lower level than the anterior, to compensate for their greater range of contraction."

"2. In the progress of the flap operation fewer stages can be defined. Made by cutting from within outwards, after transfixion of the limb, the flaps varied in shape, size, position, and number, from the single posterior one of Verduyn of Amsterdam, to the two equal lateral ones of Vermale, and the equal anterior and posterior ones of the Edinburgh school."

"Then came the battle of the schools: flap or circular."

"*Flap*.—Speedy, easy, and less painful; apt to retract, and that unequally."

"*Circular*.—Leaving a smaller wound, but more slow in performance, and apt to leave a central adherent cicatrix."

"III. The last era in amputation began after the introduction of anæsthetics. Now speed in amputation is no object, and the surgeon has full time to shape and carve his flaps into the curves most suited for

accurate apposition, and suitable relation of the cicatrix to the bone. It has also been brought clearly out that different methods of operating are suitable for different positions, and also that even in the same operation it is possible to unite the advantages of both the flap and the circular method."

"In the modified circular, which is best suited for amputation below the knee, in the long anterior flaps of Teale, Spencee, and Carden, we have illustrations of the manner in which the advantages of both the flap and circular methods have been secured, without the disadvantages of either. The long anterior flap, not like Teale's to fold upon itself, but like Spencee's and Carden's to hang over and shield the ends of the bones, and the face of a transversely-cut short posterior flap, seems to be now the typical method for successful amputations. There may be exceptions, as when the anterior skin is more injured than the posterior, or where an anterior flap would demand too great sacrifice of length of limb, but as a rule it will be found the best method for the patient."

A Few Special Indications.—With reference to the lower limb, it may be noticed that all the extensive and forcible movements of that limb, as in walking, are movements in the forward direction. At the beginning of the step the lower limb is thrown forwards. At the conclusion of the step, it gets behind the body simply through the body being moved forwards. The remark also applies to the stump left after an amputation; whether the patient walks, *i.e.*, moves an artificial limb with his stump, or sits down, the extensive and forcible movements of the stump are movements forwards. Further, the amplitude of such movements is proportionate to the length of the stump—considerable, therefore, when the limb has been amputated either at the lower part of the leg or at the lower part of the thigh, inconsiderable when the limb has been amputated either at the upper part of the leg or at the upper part of the thigh. Amputation by a long anterior flap specially commends itself in the two first-named cases, while in the two last-named, a covering made more equally from both aspects of the limb (circular, modified circular, or equal flaps) would generally seem preferable. With reference to the upper limb, very little consideration is required to establish, generally speaking, the following indications:—*Amputation of phalanges*, flap from the pulpy palmar aspect; *amputation of entire fingers (and also of toes)*, oval method, which avoids an incision and therefore a subsequent cicatrix in the palm (or sole); *amputation of the lower part of the forearm*, two short flaps of skin and fascia, one anterior, the other posterior; *amputation at the shoulder*, Spencee's modified oval method, which places the subsequent cicatrix in the least exposed position.

OPERATIONS ON THE UPPER LIMB.

LIGATURES.

Ligature of the Axillary Artery, 1st Part.—Incision below middle of clavicle extending as far outwards as edge of deltoid muscle, but avoiding the cephalic vein—this incision dividing some of the descending branches of the superficial cervical plexus. After dividing the pectoralis major, the surgeon comes upon the costo-coracoid membrane, and should identify the pectoralis minor. He then tears through the costo-coracoid membrane, avoiding, as far as possible, the numerous branches of the acromio-thoracic artery and the internal and external anterior thoracic nerves. The neuro-vascular bundle is then easily felt, running downwards and outwards. It consists of the cords of the brachial plexus externally, of the axillary vein internally, and of the axillary artery lying between and behind the vein and the cords. The aneurism needle is best passed from the inner side.

Ligature of the Axillary Artery, 3rd Part.—Incision in the axilla at junction of its

anterior and middle thirds, *i.e.*, behind the coracobrachialis and short head of the biceps, which are easily felt. The neuro-vascular bundle is very superficial, and is exposed as soon as the deep fascia is divided. The vein is internal. The artery is more or less concealed between the several nerves of the upper limb, the median nerve being in front and to its outer side, and the ulnar nerve behind and to its inner side. The aneurism needle should be passed from the inner side.

COLLATERAL CIRCULATION.—The *intercostal arteries*, including the aortic intercostals, the intercostal branches of the internal mammary, and the superior intercostal branch of the subclavian—anastomose with the superior thoracic, the long thoracic or external mammary, and the thoracic branches of the acromio-thoracic and subscapular. The *supra-* and *posterior scapular* anastomose with the subscapular. The acromial branches of the *acromio-thoracic* anastomose with the anterior and posterior circumflex.

Ligature of the Brachial Artery along the Arm.—Incision along a line drawn from junction of anterior and middle thirds of axilla to a point midway between the condyles of the humerus, avoiding the basilic vein in the lower part of the arm. Clearly expose the inner border of the biceps. The artery lies beneath it, crossed from without inwards by the median nerve. Pass the aneurism needle from the nerve.

Ligature of the Brachial Artery at the Bend of the Elbow.—Curved incision downwards

and outwards, which should be a rather long one, so as to enable the operator to easily avoid the median basilic vein, should he come upon it. Divide the bicipital or semi-lunar fascia on the director. The artery will be found between the tendon of the biceps, which is on its outer side, and the median nerve, which is on its inner side. The aneurism needle should be passed from the inner side.

COLLATERAL CIRCULATION.—The *superior profunda* anastomoses on the outer side of the elbow with the radial recurrent and the interosseous recurrent, and gives off an articular branch which joins with the *anastomotica magna*. The *inferior profunda* anastomoses on the inner side of the elbow with both the anterior ulnar recurrent, and with the posterior. The *anastomotica magna* anastomoses with the above, and forms a more or less direct communication between the two profundæ through the articular branch above named.

Ligature of the Ulnar Artery.—The ulnar artery is accessible in its lower two-thirds only. In this part of its course it runs along a line drawn from the inner condyle of the humerus (or from a point a little external to it) to a point a little external to the pisiform bone, along which line the incision for tying it should be made. It lies between the flexor carpi ulnaris and the innermost tendons of the flexor sublimis digitorum, and has the ulnar nerve to its inner side. The aneurism needle should be passed from the inner side.

COLLATERAL CIRCULATION.—Anastomosing with the superficial palmar arch is either the *superficialis volæ*, or the *radialis indicis*, or sometimes the *princeps pollicis*—branches, all three, of the radial. In the palm of the hand the *deep palmar arch* inosculates with the deep or communi-

eating branch of the ulnar. On the back of the wrist, there is the communication between the posterior carpal branches of the radial and ulnar to form the *posterior carpal arch*, into which opens also the posterior interosseous.

Ligature of the Radial Artery.—Incision along a line drawn from a point midway between the condyles of the humerus to a point a little internal to the styloid process of the radius.

In its LOWER THIRD, the artery is situated between the tendons of the supinator longus and flexor carpi radialis, immediately beneath the deep fascia, and has no nerve accompanying it. The aneurism needle may be passed from either side.

COLLATERAL CIRCULATION. — On the back of the wrist, the *posterior carpal branch of the ulnar* and the *posterior interosseous* anastomose with the posterior carpal branch of the radial. In the palm of the hand, we have the anastomosis between the *deep or communicating branch of the ulnar* and the termination of the radial, forming the deep palmar arch, which latter is also joined by twigs from the anterior interosseous. The *superficial palmar arch* of the ulnar also joins either with the superficialis volæ, or with the radialis indicis, or princeps pollicis.

In its MIDDLE THIRD, the artery lies between the muscles above named, which are here becoming fleshy, and it has the radial nerve to its outer side. The aneurism needle should here be passed from the outer side. Collateral circulation as above, also through numerous muscular branches.

In its UPPER THIRD, the artery lies just beneath the thin inner edge of the fleshy portion of the supinator longus. To tie it here, after making the incision

along the line above indicated, look for the edge of the supinator longus, and raise it carefully. The artery will be found immediately beneath it, covered by a thin layer of fascia, which will require to be torn through. It has no nerve accompanying it. The aneurism needle may be passed from either side. Collateral circulation as above.

AMPUTATIONS, &c.

Amputation of a Terminal Phalanx.—Flex the phalanx. Enter the joint from behind (see page 21), and divide the lateral ligaments. Make an anterior flap extending to near the tip of the finger.

Amputation of a Finger.—Oval Method.
—Begin dorsal incision three-quarters of an inch above the knuckle; a little higher if the head of the metacarpal bone is to be removed. Cut downwards as far as the knuckle; then cut obliquely into the web on either side, keeping the knife *well upon the finger*; cut transversely *in the line of junction of the finger with the palm*. Divide tendons and ligaments, and disarticulate.

The removal of the head of the metacarpal bone with cutting pliers diminishes the subsequent deformity, but weakens the hand.

Amputation of a Finger, with Part of the Metacarpal Bone.—Same incision as above, only beginning higher up. The finger is not to be disarticulated, but the metacarpal bone is to be separated from the soft parts, and divided with cutting pliers. Its lower part is then to be removed along with the finger.

Amputation of the Thumb.—An operation very rarely required. Make a palmar flap by transfixion from the thenar eminence, entering the knife, on the left side, opposite the carpo-metacarpal joint, and on the right side, in the web. Make a small dorsal flap by carrying the knife across the back of the metacarpal bone from one extremity of the palmar incision to the other. The position of the articulation is indicated by the tubercle on the base of the first metacarpal bone, easily felt in the “anatomical snuff-box” (see pp. 20 and 21).

PARTS DIVIDED IN PALMAR FLAP.—In the palmar flap there will be divided the abductor and the opponens pollicis, the two heads of the flexor brevis with the flexor longus between them, and the adductor; the princeps pollicis artery, and probably also the superficialis volæ; digital branches of the median nerve, and filaments of the musculo-cutaneous.

PARTS DIVIDED IN DORSAL FLAP.—In the dorsal flap there will be divided the extensores ossis metacarpi, primi and secundi internodii pollicis, and the outer head of the first dorsal interosseous muscle or abductor indicis; the dorsales pollicis arteries; digital branches of the radial nerve, and filaments of the musculo-cutaneous. The trunk of the radial artery must be carefully avoided in disarticulating, as it lies just on the inner side of the base of the metacarpal bone. For the sub-cutaneous structures divided, see structures divided in the amputation at the wrist.

Amputation at the Wrist.—Mark out a semicircular flap in the palm of the hand from one styloid process to the other, cutting deeply into the tissues of the palm. Make a dorsal incision between the same points, and enter the joint from behind. Divide the lateral ligaments, and complete the palmar flap by cutting from the deeper parts to the surface, seeing that the knife does not hitch either against the pisiform bone or against the unciform process of the unciform.

PARTS DIVIDED IN PALMAR FLAP.—In the palmar flap there will be divided the superficial palmar interosseous or digital branches of the superficial palmar arch, and the superficialis volæ and princeps pollicis branches of the radial, the origins of the median and anterior ulnar veins, the palmar cutaneous branches of the median and ulnar nerves, and terminal filaments of the internal and external cutaneous nerves; the palmar fascia; the abductor, opponens, flexores longus and brevis, and adductor pollicis; the abductor, flexor brevis, and adductor or opponens minimi digiti; the digital branches of the median and ulnar nerves; the tendons of the flexores sublimis and profundus, and, with the latter, the four lumbricales.

PARTS DIVIDED IN DORSAL INCISION.—In the dorsal incision there will be divided the origins of the radial and posterior ulnar veins, the radial nerve and the dorsal cutaneous branch of the ulnar; and beneath the posterior annular ligament and deep fascia, the following tendons passing through six grooves and six synovial sheaths, namely: (1) extensor ossis metacarpi and primi internodii pollicis; (2) extensores carpi radiales longior and brevior; (3) extensor secundi internodii pollicis; (4) extensores indicis and communis digitorum; (5) extensor minimi digiti; (6) extensor carpi ulnaris. The radial artery will be divided between the extensores ossis metacarpi and primi internodii pollicis, on the one hand, and the extensor secundi internodii pollicis, on the other. The dorsal incision may lie either a little above or a little below the level of the posterior carpal arch; in the former case there would be divided the origins of the arch with the termination of the posterior and anterior interosseous arteries, in the latter case the dorsal interosseous.

Lister's Excision of the Wrist.—Two lateral incisions (further described below), through which—

1. The flexor and extensor tendons of the carpus are divided, except the flexor carpi ulnaris.
2. The tendons of the fingers and thumb are raised from their grooves.
3. The carpus, the bases of the metacarpal bones, and the lower extremities of the radius and ulna are removed with cutting pliers.
4. The bases of the metacarpal bones and the lower extremities of the radius and ulna are trimmed with the saw.

The two lateral incisions are made as follows :—

The *external incision* is begun on the back of the lower extremity of the radius, and is carried, first downwards and outwards parallel to, but internal to, the extensor secundi internodii pollicis, and then directly downwards over the upper half of the back of the 2nd metacarpal bone. Through this incision the extensores carpi radialis longior and brevior are divided, the soft parts are raised from off the base of the metacarpal bone of the thumb and the outer and back part of the wrist, and the trapezium is separated by cutting pliers from the remainder of the carpus.

The *internal incision* is made over the inner side of

the upper half of the 5th metacarpal bone, and over the lower part of the ulna. Through this incision the extensor carpi ulnaris is divided, and the soft parts are raised from the front and the back of the carpus and lower part of the ulna.

The mode of dealing with the pisiform bone and with the unciform process of the unciform is a matter of some importance. It will be noticed that these bony points give origin to the muscles of the hypothenar eminence, and, further, that the pisiform bone, through giving attachment to the flexor carpi ulnaris, establishes a connection between the latter muscle and the portion of the hand which is to be left. They must both be preserved. The unciform process is to be nipped off from the unciform bone with cutting pliers. The pisiform bone, after being separated from the cuneiform, is to have its articular surface removed with cutting pliers.

The soft parts being raised as far as may be necessary, parts 3 and 4 of the operation will become relatively easy.

Amputation of the Forearm.—Place the fore-arm in a position intermediate between pronation and supination, and make two short flaps, one anterior and the other posterior. It will be noticed that, the limb being flattened from before backwards, the flaps need not be long. In the lower part of the forearm,

they should be made of skin and fascia only, there being nothing but tendons beneath. In amputating higher up, the muscles may be taken up to a certain extent, especially in front.

Excision of the Elbow-Joint.—Forearm slightly flexed. Make a vertical incision about four inches long over the back of the joint straight down to the bone. Dissect the soft parts from off the olecranon and the condyles, being careful, on the inner side, not to injure the ulnar nerve; the nerve is not likely to be injured if the operator cuts parallel to the axis of the limb, and keeps close, first to the inner border of the olecranon, and then to the posterior surface of the inner condyle. The olecranon may now be removed with cutting pliers, the joint being freely opened. Saw off the lower part of the humerus and the upper part of the radius and ulna. In clearing the outer side of the olecranon, it is most important to keep the tendon of the triceps continuous both with the anconeus and with the deep fascia of the forearm (see note, page 103).

Amputation of the Arm.—The circular method is here particularly applicable:—Circular sweep through the skin, which is then dissected up for about an inch. Fascia and muscles divided circularly down

to the bone, and retracted. The bone is then cleared for a sufficient distance, and sawn through.

Excision of the Shoulder.—Straight incision down to the bone, beginning just below the acromio-clavicular articulation. Open up the bicipital groove, and turn out the tendon of the long head of the biceps. Divide the capsule with the muscles inserted into it,* an assistant rotating the limb alternately inwards and outwards, so that the several parts of the capsule may come in succession under the knife. Project the head of the humerus, and saw it off. The glenoid cavity may require scraping.

Amputation at the Shoulder-Joint.—**Spence's Modification of the Oval Method.**—Vertical incision down to the bone, beginning below the acromio-clavicular articulation (the same incision as that already made for the excision, so that the operation begun as an excision may be transformed into an amputation). Then make an oblique incision straight down to the bone from the lower

* In all excisions the periosteum should be left as far as possible. This is relatively easy when it is swollen and loosened by inflammation; thus in the excision of the shoulder for disease the surgeon should be able, with a proper raspatory, to separate the periosteum and the muscles inserted into the tuberosities from the subjacent bone, instead of dividing the capsule as above indicated. In all excisions, also, no more bone should be sawn off than can be helped; some diseased cancellous tissue may be gouged away, if necessary.

extremity of the former incision, and over the outer aspect of the limb, to the lower part of the posterior fold of the axilla. The flap thus made is then turned up, and the capsule is exposed and divided, the humerus being rotated as above explained. The soft parts remaining on the inner side of the limb are now divided by cutting straight into the axilla; these soft parts, as they contain the axillary artery, being caught hold of by an assistant before the artery is divided.

In the original oval method the first incision (handle of the racket) was made on the outer side of the limb, beginning on the acromion; this had the inconvenience of leaving the cicatrix in a somewhat exposed situation.

PARTS DIVIDED.—The *vertical incision* divides the anterior part of the deltoid, with the subjacent anterior circumflex artery, and twigs from the acromio-thoracic; the cephalic vein and the descending branch of the acromio-thoracic artery; a part of the insertion of the pectoralis major. The *oblique incision* on the outer side of the limb divides the outer and back part of the deltoid, the long head of the triceps, the teres major and latissimus dorsi, with the posterior circumflex vessels and nerve. *With the capsule* there are divided the subscapularis, supraspinatus, infraspinatus, and teres minor. The *final cut* into the axilla divides the previously undivided portion of the pectoralis major, the biceps and the coraco-brachialis, the axillary vessels, and the nerves to the upper limb.

When time is an object, as may be the case on the battle-field, the shoulder may be amputated by an external or deltoid flap, made, at least in its lower part, by transfixion.

OPERATIONS ON THE ABDOMEN.

Ligature of the Arteries of the Brim of the Pelvis (COMMON, EXTERNAL AND INTERNAL ILIACS, AND ABDOMINAL AORTA).—The essential point about the incision for tying either of these arteries is that, in its lower part, it should run parallel to, and lie a little above, the *outer half* of Poupart's ligament, *not in any case extending further inwards than the middle of the ligament, so that the deep epigastric artery be not interfered with.* Externally, for the sake of obtaining the necessary access, the incision may be prolonged to any requisite extent, either in the direction of the umbilicus (Murray, South, Abernethy), or towards the last rib (Sir P. Crampton). The external and internal oblique and the transversalis muscles being divided, the fascia transversalis is exposed and carefully divided on the director. The peritoneum is now pushed away from off the iliacus and psoas. The common and external iliac arteries are easily found in the loose cellular tissue along the inner border of the psoas,—the corresponding veins being *internal* to the arteries, except the *right* common iliac, which is posterior below and external above. The aneurism needle must be passed from the vein.

The internal iliac could be easily traced downwards from the bifurcation of the common trunk; its vein is internal and posterior to it. The abdominal aorta has been tied eight times, but never successfully.

COLLATERAL CIRCULATION.—In the case of *either of the two first-named arteries*, there is the anastomosis of the superior epigastric branch of the internal mammary with the deep and superficial epigastric branches of the external iliac and femoral. In the case of the *common iliac*, there are the anastomoses of the last lumbar artery with the ilio-lumbar and circumflex iliac; of the vesical and hæmorrhoidal arteries,—and, in the female, of the uterine and vaginal,—of one side with those of the other,—these anastomoses of the visceral arteries bringing the blood into the internal iliac artery on the side of the ligature, from whence it would get into the external iliac and femoral. In the case of the *external iliac*, there are, further, the anastomoses of the gluteal and circumflex iliac with the ascending branch of the external circumflex; of the obturator and sciatic with both circumflex; of the *comes nervi ischiadici* with the terminal and perforating branches of the profunda.

Lumbar Colotomy.—Usually performed on left side. Hard pillow under right side of abdomen. Incision downwards and outwards, midway between the last rib and the crest of the ilium, beginning at the outer border of the erector spinæ, the centre of which should correspond to a point midway between the anterior and posterior iliac spines. The incision divides skin and superficial fascia, portions of the external oblique and latissimus dorsi, of the internal oblique and transversalis, the outer part of the quadratus lumborum, a portion of the lumbar fascia, and the fascia transversalis. The lower end of the kidney is easily felt below the last rib; this is the guide to the colon, which passes down in front of the kidney. The

colon should be identified by its muscular bands and sacculated appearance. It is to be drawn to the surface, stitched to the edges of the wound, and opened between the stitches; a plug is subsequently fitted to the opening.

Inguinal Colotomy. — The laxity of the sigmoid meso-colon has been utilised by Mr. Herbert Allingham in his operation of inguinal colotomy for cancer of the rectum. The laxity of this fold is sufficient to allow of a knuckle of the sigmoid flexure being drawn out through an abdominal wound made above the outer part of Poupart's ligament, and of its being fixed outside the abdomen till adhesions are established. Upon these being found sufficiently firm, the projecting part of the knuckle is excised. The posterior wall of the knuckle, more or less folded upon itself, is then found to constitute an *éperon* or spur similar to that described by Dupuytren in artificial anus. This arrangement now prevents the *fœces* from passing down into, and irritating, the lower and diseased part of the bowel.

Nephrotomy, Nephro-Lithotomy, Nephrectomy. — The incision for lumbar colotomy allows the surgeon to reach the kidney for the purposes of either of the two former operations, and,—if to the oblique incision a vertical incision through its

middle be added,—for the purposes of nephrectomy. In the latter operation, the pedicle of the kidney being got at, an aneurism needle armed with a double ligature is passed between the vessels, on the one hand, and the ureter, on the other. Both ligatures are tied, after which the kidney can be removed.

Castration.—Free incision from the external abdominal ring down to the bottom of the scrotum. As soon as the cremasteric fascia is exposed (covered by a thin prolongation of the intercolumnar fascia), the cord and testicle, with their deeper coverings, can be shelled out of the scrotum. The cord, after being secured with a clamp, is divided, and its vessels are tied separately with carbolised catgut. Some surgeons embrace the whole cord in one stout ligature. It is, of course, important that bleeding from the cord be stopped before the cord is allowed to retract into the inguinal canal. Any diseased portion of the scrotum should, of course, be removed.

Amputation of the Penis.—Penis clamped, or constricted with a tape; skin maintained in its natural position, neither drawn backwards nor drawn forwards. Cut off the organ behind the disease, and secure the two dorsal arteries of the penis and the two arteries of the corpora cavernosa. Half an inch of the urethra must now be slit up on its under

surface, and the mucous membrane attached to the skin; or, having divided the skin, one may divide first the corpora cavernosa, and then the corpus spongiosum & the urethra half an inch in front of former. The urethra may then be slit up on its *upper* surface.

OPERATIONS ON THE LOWER LIMB.

LIGATURES.

Ligature of Femoral Artery at Apex of Scarpa's Triangle (Superficial Femoral).—

Thigh slightly flexed and abducted. Incision along the line of the artery, *i.e.*, along a line drawn from a point midway between anterior superior spine of ilium and symphysis pubis to inner side of inner condyle of femur. Expose inner border of sartorius (the muscle will be recognised by the direction of its fibres, *downwards* and *inwards*), and draw it *outwards*. The artery lies just internal to the muscle. The internal or long saphenous nerve is anterior and external to the artery, and at a slight distance from it; the vein is internal and somewhat posterior. The aneurism needle should be passed from the inner side.

Ligature of Femoral Artery in Hunter's Canal. —Thigh as above. Incision in middle third of thigh over the line of the artery. Find the sartorius, and draw it *inwards*, and thus expose the

anterior wall of Hunter's canal. The position of the artery being recognised by the finger, the anterior wall of Hunter's canal is to be divided over the artery on a director. The long saphenous nerve is antero-external to the artery and close to it; the vein is postero-external. The aneurism needle is most conveniently passed from the inner side.

COLLATERAL CIRCULATION.—The *perforating branches of the profunda* anastomose with the two superior articular branches of the popliteal; the *descending branch of the external circumflex* anastomoses with the superior external articular.

The **Common Femoral** is not usually tied, on account of the danger of secondary hæmorrhage resulting from the vicinity of the large profunda branch. It would easily be found by an incision along the line indicated, begun just below Poupart's ligament.

COLLATERAL CIRCULATION.—The *gluteal* and the *circumflex iliac* anastomose with the ascending branch of the external circumflex, and with the superficial circumflex iliac. The *sciatic* and *obturator* arteries anastomose with both circumflex. The *comes nervi ischiadici* anastomose with the perforating branches of the profunda.

Ligature of the Anterior Tibial Artery.

—Incision along a line drawn from a point a little internal to head of the fibula to a point midway between the two malleoli. A more or less distinct white line in the deep fascia (the first one from the inner border of the tibia) marks the interspace between the tibialis anticus and the extensor longus digitorum. Divide the deep fascia over this line. Open up the muscular interspace, and work your way towards the in-

terosseous membrane, keeping close to the tibialis anticus, so as not to get, as it is easy to do towards the middle of the leg, on the outer side of the extensor proprius pollicis. The anterior tibial vessels and nerve will be found on the interosseous membrane, the nerve being more or less external to the artery. The aneurism needle should be passed from the outer side.

At the lower part of the leg the tendon of the extensor proprius pollicis crosses, and gets internal to, the artery; but it is best to draw the tendon outwards, and to seek the artery on its inner side.

COLLATERAL CIRCULATION.—The collateral circulation through the posterior tibial and peroneal is so free that its channels need scarcely be enumerated. One may note, however, the inosculation of the *external plantar* with the dorsalis pedis at the back part of the first interosseous space; and, at the ankle, the anastomosis of the *anterior peroneal* both with the external malleolar and with the tarsal and metatarsal, and that of the *internal plantar and internal calcanean* with internal malleolar.

Ligature of the Dorsalis Pedis Artery.—

Incision from back part of first interosseous space nearly to a point midway between the two malleoli. Find the extensor proprius pollicis and the innermost tendon of the extensor longus digitorum. Emerging from beneath the latter will be seen the innermost tendon of the extensor brevis. The artery lies between the latter tendon, which crosses it towards its termination, and the tendon of the extensor proprius pollicis. It is frequently concealed to some extent

by the layer of deep fascia which unites the sheaths of the adjoining tendons. The inner branch of the anterior tibial nerve lies on its outer side. It is best to pass the aneurism needle from the outer side.

Ligature of the Popliteal Artery.—Incision in the middle line of the popliteal space, mainly above the line of the articulation. Divide skin and fascia, avoiding the external or short saphenous vein. Flex the limb, so as to relax the hamstring muscles, and draw them apart. The internal popliteal nerve will probably be the first structure come upon. The popliteal vessels lie to its inner side, and deeper, resting on the femur in the inner part of the wound. The vein is external and posterior to the artery, and close to it. The aneurism needle should be passed from the outer side.

COLLATERAL CIRCULATION.—The *articular arteries* communicate freely one with the other. The superior external articular anastomoses with the *descending branch of the external circumflex*. Both superior articular anastomose with the *perforating branches of the profunda*.

Ligature of the Posterior Tibial Artery, Middle Third.—Incision about an inch from the inner border of the tibia. Identify the inner head of the gastrocnemius, and, consequently, the soleus, which lies beneath it. Cut carefully through the soleus, looking for the glistening layer of fascia on its anterior surface. Divide this on the director, and thus expose the layer of intermuscular fascia which

binds down the posterior tibial vessels and nerve upon the deep muscles of the back of the leg. This layer of fascia should be torn through. The nerve is external to the artery. The aneurism needle should be passed from the outer side.

The artery may be got at by separating the soleus from the inner border of the tibia, instead of cutting through the muscle.

Ligature of the Posterior Tibial Artery, Lower Third.—The gastrocnemius and soleus having here contracted into the tendo Achillis, an incision midway between this latter tendon and the inner border of the tibia will expose the deep muscles, on the surface of which the posterior tibial vessels and nerve will easily be found. The nerve is external to the artery. The aneurism needle should be passed from the outer side.

COLLATERAL CIRCULATION.—The *dorsalis pedis*—the continuation of the anterior tibial—inosculates with the external plantar, one of the branches of bifurcation of the posterior tibial. The *peroneal* artery anastomoses with the posterior tibial by means of the communicating. The *internal malleolar* communicates with the internal plantar and the internal calcaneal. The *anterior peroneal*, the *external malleolar*, and the *tarsal* and *metatarsal* communicate with the external plantar.

AMPUTATIONS, &c.

Amputation of a Toe.—Oval method, as in case of a finger (see p. 97). The flap method (two lateral flaps) is sometimes adopted, but it has the

disadvantage of leaving a cicatrix in the sole of the foot. Note that in the case of the toes the joint lies further behind the web than in the case of the fingers.

Lisfranc's, or Tarso-metatarsal Amputation.—Left hand to grasp sole of foot, finger and thumb marking bases of 5th and 1st metatarsal bones, the former always easily felt (see p. 42). Dorsal incision slightly convex forwards between points named, *i.e.*, a little forwards and inwards from base of 5th metatarsal bone. Long plantar flap, longest internally, extending as far as middle of ball of big toe, to be marked out by a deep cut running parallel to line of attachment of toes, but not completed in the first instance.

Disarticulate the three outer metatarsal bones (they lie in a line oblique forwards and inwards) and the 1st metatarsal bone (it lies just a little in front of the line of the three outer ones).

To disarticulate the 2nd metatarsal bone introduce the point of the knife, blade upwards, into the back part of the first interosseous space; then, holding the knife as a dagger in stabbing, press it backwards so as to divide the interosseous ligament between the internal cuneiform and the base of the 2nd metatarsal, and at the same time press the front part of the foot downwards: the dorsal ligaments being divided, the joint will open.

Divide the plantar ligaments and the tendons of the peronei longus and brevis; pass the knife beneath the metatarsal bones, and complete the plantar flap, keeping the sole of the foot towards you.

PARTS DIVIDED IN DORSAL INCISION.—Skin; superficial fascia containing venous arch on dorsum of foot, with origins of internal and external saphenous veins; the corresponding nerves, also the internal & external branches of the musculo-cutaneous; deep fascia; tendons of extensor longus digitorum, extensor proprius pollicis, peroneus tertius, and part of tendon of tibialis anticus; fleshy portion of the extensor brevis digitorum; dorsalis pedis artery, with its metatarsal branch and one or more of the dorsal interosseous branches given off from the latter; internal branch of anterior tibial nerve.

PARTS DIVIDED IN PLANTAR FLAP.—Skin; thick stratum of subcutaneous fat containing the digital vessels and nerves; slips of the plantar fascia to the toes; flexor brevis digitorum, abductor pollicis, abductor minimi digiti; flexor longus digitorum, with the lumbricales; flexor longus pollicis. The muscles of the the third layer—that is, the flexor brevis and adductor pollicis, the flexor brevis minimi digiti, and the transversus pedis—will be divided more or less obliquely, the latter perhaps escaping altogether. The plantar vessels and nerves should be divided as far forwards as possible, the surgeon keeping as close as he can to the bones when completing the plantar flap.

Hey's Amputation differs from the above in that the metatarsal bones are sawn through near their bases instead of being disarticulated.

Chopart's, or Medio-tarsal Amputation.
—Left hand to grasp sole of foot, finger and thumb marking the tubercle of the scaphoid and the line of the calcaneo-cuboid articulation (the former always easily felt—see p. 42). Dorsal incision slightly convex forwards between points named, *i.e.*, across the foot over the tubercle of the scaphoid. Plantar flap, like

that in Hey's or Lisfranc's, only a little shorter—extending to base of ball of big toe—to be marked out by a deep cut running parallel to line of attachment of toes, but not completed in the first instance.

Feel for the tubercle of Chopart (the anterior projecting part of the os calcis, which rises above the level of the cuboid), and open the calcaneo-cuboid joint, which lies immediately in front of this tubercle. The joint between the astragalus and the scaphoid lies internal and just a little further back. (Beware of getting between the scaphoid and the three cuneiforms instead of opening the astragalo-scaphoid joint.)

Complete the plantar flap as in Hey's or Lisfranc's amputation, dividing the tibialis posticus and peroneus longus (and the peroneus brevis, if it has not already been divided), and the plantar ligaments.

PARTS DIVIDED IN DORSAL INCISION. —Skin; superficial fascia containing the internal and external saphenous veins and nerves, and the internal and external branches of the musculo-cutaneous nerve; deep fascia; tendons of the tibialis anticus, extensor longus digitorum, extensor proprius pollicis, and peroneus tertius,—perhaps also the peroneus brevis; fleshy portion of the extensor brevis digitorum; dorsalis pedis artery, with its tarsal branch, and probably the anastomosis of the latter with the anterior peroneal and the external malleolar, also small anastomosing branches between the internal malleolar and the internal calcanean; internal and external branches of the anterior tibial nerve.

PARTS DIVIDED IN PLANTAR FLAP.—Skin; thick stratum of subcutaneous fat containing small branches of the plantar vessels and nerves, and twigs from the plantar cutaneous nerve; plantar fascia, with its slips to the toes; flexor brevis digitorum, abductor pollicis, abductor minimi digiti; flexor longus digitorum, with the origins of the lumbricales; flexor longus pollicis. Three of the muscles of the third layer—the flexor

brevis and adductor pollicis, and the flexor brevis minimi digiti—will be divided more or less obliquely, and so may also, perhaps, the flexor accessorius, which latter muscle should, however, escape division. The plantar vessels and nerves should be divided as far forwards as possible, the surgeon keeping as close as he can to the bones when completing the plantar flap.

Syme's and Pirogoff's Amputations at the Ankle-Joint.—In the way of performing these operations now very frequently adopted, it may be left undecided which of the two is to be performed till the latter stage of the operation is reached.

Left hand to grasp back of heel, finger and thumb marking out, on the one hand, the external malleolus, and, on the other, a point exactly opposite on the inner side of the foot—this point being considerably below and behind the internal malleolus.

Dorsal incision between the points named. Open the joint, remembering that the lateral ligaments radiate from the malleoli, and that, to divide them, the knife should be carried round these processes, and close to them.

SYME'S AMPUTATION.—To complete as a Syme, make an incision across the sole of the foot joining the points above named, this incision to be carried down to the os calcis. Drawing the foot forward, divide the tendo Achillis, and dissect the os calcis from out of the heel flap, keeping close to the bone, especially on the inner side. Saw off the lower part of the tibia and fibula.

PIROGOFF'S AMPUTATION.—To complete as a Pirogoff, cut downwards and forwards from the points above named on either side of the heel, and join the two oblique incisions by a transverse incision across the sole of the foot. Then saw through the os calcis in the line of the incisions just made, leaving the back part of the bone in the heel flap. Saw off a little more of the tibia and fibula than in the case of the Syme.

ORIGINAL WAY OF DOING A SYME.—Mark out the heel flap as above. The foot being supported with the sole towards you, dissect up the heel flap from off the os calcis, pressing the flap down with the left thumb, and keeping the knife close to the bone, especially on the inner side. Divide tendo Achillis, make the dorsal incision, disarticulate, and saw off the lower part of the tibia and fibula.

PARTS DIVIDED IN DORSAL INCISION.—Skin ; superficial fascia containing the internal or long saphenous vein and nerve, the two branches of the musculo-cutaneous nerve, small twigs from the internal and external malleolar and anterior peroneal arteries ; tendons of the tibialis anticus, extensor longus digitorum, extensor proprius pollicis, and peroneus tertius ; possibly the tendon of the tibialis posticus, which latter tendon, however, may be divided in the heel flap ; the anterior tibial artery, with the anastomosis of its external malleolar branch with the tarsal and anterior peroneal ; the anterior tibial nerve.

PARTS DIVIDED IN MAKING HEEL FLAP.—Skin ; thick stratum of subcutaneous fat containing the short or external saphenous vein and nerve, the plantar cutaneous nerve, the internal calcanean artery ; the peronei longus and brevis ; the fleshy portion of the extensor brevis digitorum, in the case of the Pirogoff, and also in the case of the Syme if the heel flap is made unusually large ; the flexor brevis digitorum, abductor pollicis, abductor minimi digiti ; the flexor longus pollicis ; the flexor

ongus digitorum, with (in the case of the Syme) the two origins of the flexor accessorius; in the case of the Syme, either the internal and external plantar vessels and nerves, or possibly the posterior tibial, if the heel incision is made rather far back; in the case of the Pirogoff, the internal and external plantar.

Amputation of Lower Part of Leg.—

Long anterior flap of skin and superficial fascia only; short (or no) posterior flap; partly saw tibia; while doing so, saw fibula; complete section of tibia. Saw off small portion of crest of tibia, or remove same with cutting pliers.

This is the best place to do a *Teale*, especially if skin on dorsum of foot is healthy, and can be used to make the long anterior flap. Measure circumference of limb with piece of tape. Take half the piece, and lay same across front of limb, marking extremities of same with pen or pencil. Similarly mark out the two other angles of anterior or square flap by measuring downwards on either side of limb, and transversely below. Turn up soft parts down to the bone. Short posterior flap one-fourth of anterior—*i.e.*, one-fourth of half circumference of limb.

Amputation of Upper Part of Leg.—

Circular; or make two equal flaps of skin only, or of skin and a little muscle at upper part. First flap may be made antero-external, including soft parts from fibula to inner border of tibia; then the postero-internal flap may be made by transfixion. But such a flap is likely to be thick and heavy, and to retract too much.

Amputation through Knee - Joint ; Carden's Amputation through Femoral Condyles.—In either case make an anterior flap of skin and fascia about five or six inches long. In former operation, disarticulate, and make a short posterior flap from within outwards, *i.e.*, by cutting from the deeper parts to the skin. In latter operation, make a short posterior flap by transfixion, and saw through condyles. In either operation, the patella, if healthy, may be left; in amputation through the condyles, its articular surface may be removed (Gritti's operation).

Excision of Knee-Joint.—Stand opposite knee, which should be flexed. Transverse incision between patella and tubercle of tibia slightly curved up on either side on the femoral condyles, Enter joint, thoroughly dividing lateral ligaments. Divide crucial ligaments downwards on head of tibia. Saw off upper part of tibia and lower part of condyles, the tibia being drawn forwards from the popliteal artery (this is easy when the lateral ligaments are well divided). The saw-cuts through the bones must be at right angles to the respective shafts.*

*In the case of the femur, the saw-cut, though made at right angles to the shaft from before backwards, may advantageously, in the transverse direction, be made to incline slightly downwards and inwards, in a direction parallel to the under surface of the condyles, of which the inner one descends somewhat lower than the outer one. (See also note, page 103.)

Amputation of Lower Part of Thigh.

—Circular; modified circular; lateral flaps by transfixion; or long anterior and short posterior flaps, as follows:—

Make a long anterior flap from without inwards, taking skin only below, skin and muscles above; make a short posterior flap by transfixion.

Amputation through Middle or Upper Part of Thigh.—Same methods as above, but here

the anterior and posterior flaps may be of equal length, or nearly so. The modified circular—short anterior & posterior skin flaps and circular division of the muscles—is the method generally adopted.

Excision of Hip-Joint.—Thigh flexed and adducted. Joint to be entered by an incision behind great trochanter, and curving slightly forwards above it. Head of femur to be levered out by forcibly rotating limb inwards, and sawn off. Cotyloid cavity may require scraping. With a good assistant to manage lower limb, this is a relatively easy operation when the joint is diseased. In the healthy subject, the operation is somewhat difficult. (See note, page 103.)

PARTS DIVIDED.—Greater part of insertion of the glutens maximus, glutens medius, inferior branch of superior gluteal nerve, and inferior branch of deep division of gluteal artery; then, from above downwards, glutens minimus, pyriformis, obturator internus and gemelli, obturator

externus, quadratus femoris, and part of adductor magnus, with branches from the sciatic, obturator and external circumflex arteries, and the terminal branch of the internal circumflex ; capsule of the joint, with the round ligament or ligamentum teres.

Amputation at Hip-Joint.—Flap Method.

—Thigh flexed, and, at first, rotated slightly outwards, so as to get the great trochanter well back. Long knife entered midway between anterior superior spine of ilium and great trochanter, passed downwards and inwards below and parallel to Poupart's ligament, and brought out opposite tuberosity of ischium. The point will impinge at first upon the femur, when it must be raised, in doing which the capsule of the joint will probably be opened. Cut an anterior flap some six or eight inches long. Disarticulate, the limb being forcibly abducted and rotated outwards. The limb being now rotated inwards, so as again to get the great trochanter out of the way, cut a posterior flap about four inches long.

The flap amputation at the hip probably leaves nothing to be desired as regards the flaps themselves, or the ease and rapidity with which they can be cut. But the great drawback of the operation is the hæmorrhage which accompanies it, especially from the arteries of the buttock—the gluteal and the sciatic—unless special means be adopted. The elastic tourniquet can scarcely be applied high enough to be thoroughly efficient, and it would be most unsafe

to trust to digital compression, either of the femoral on the pubes, or of the common iliac through the walls of the abdomen. One must therefore have recourse either to the aortic tourniquet or to Davy's lever, which latter instrument, in the hands of its skilful and practised inventor, has given most satisfactory results. The danger of hæmorrhage is in a great measure averted by the adoption of Furneaux Jordan's oval operation, below described.

PARTS DIVIDED IN MAKING THE ANTERIOR FLAP. — The knife first pierces, and divides somewhat variable portions of, the tensor vaginæ femoris, glutei medius and minimus, and psoas and iliacus; then, passing beneath the femoral and profunda vessels, it pierces and divides a variable extent of the pectineus, probably puncturing also the capsule of the hip-joint. As the knife is pushed onwards it pierces, and divides variable portions of, the adductor brevis, the adductor magnus, and the gracilis.

As the knife cuts its way downwards and then forwards, it divides further portions of the muscles named, also portions of the vasti externus & internus and crureus, and the rectus, sartorius, and adductor longus. The femoral vessels and the internal or long saphenous nerve are divided between the adductor longus and the vastus internus, behind the sartorius; the profunda vessels are divided behind the adductor longus, sometimes a little higher up, in front of the pectineus. Just before the completion of the flap, there are divided the internal or long saphenous vein, and the internal, middle, and external cutaneous nerves, all situated in the superficial fascia.

PARTS DIVIDED IN MAKING THE POSTERIOR FLAP. — In making the posterior flap, the surgeon divides the ligamentum teres and back part of the capsule; the remaining portions of the muscles already named; the obturator externus, with branches of the obturator artery and nerve; the pyriformis, the obturator internus and the gemelli, the quadratus femoris, and branches of the sciatic and gluteal arterics and superior gluteal nerve. The great sciatic nerve is divided in the lower part of the flap, just before the hamstring muscles and the gluteus maximus. In the superficial fascia are divided the small sciatic nerve, and twigs from the inferior pudendal.

Amputation at the Hip-Joint. — Oval Method (Furneaux Jordan's). — A circular amputation is performed at the upper third of the thigh in the ordinary way, vessels being tied and bone sawn through. Then an incision down to the bone is begun a little above the great trochanter, and carried down the outer side of the limb to meet the circular incision. The flaps being raised at their angles, the bone is rapidly freed all round up to the hip-joint, and then disarticulated, bleeding vessels being secured as fast as they are divided.

The operation may be slightly modified (Lister and other surgeons) by the vertical incision being made first, in which case the angles of the flaps would be rounded off.

PARTS DIVIDED.—The reader need scarcely be helped with reference to the parts cut through in the circular amputation. The vertical incision divides merely the fascia lata and, with the vastus externus, a portion of the gluteus maximus, and branches of the external circumflex artery. In freeing the bone there is nothing of importance divided, save the muscles which are attached to the same, and some of the muscular branches.

OPERATIONS ON THE HEAD AND NECK.

Ligature of the Common Carotid Artery.

—Incision along the anterior border of the sterno-mastoid, *i.e.*, along a line drawn from the sterno-clavicular articulation to a point midway between the angle of the jaw and the mastoid process. For the ligature above the omo-hyoid muscle (the most convenient situation for tying the artery) the middle of the incision should correspond to the cricoid cartilage. Divide skin, superficial fascia, platysma, deep fascia; draw back the sterno-mastoid, and define the omo-hyoid. The artery will be found just above the latter muscle. The internal jugular vein lies on its outer side; the pneumo-gastric nerve lies between and behind the two vessels; the cord of the sympathetic lies behind the sheath of the artery; the descendens noni nerve crosses the sheath anteriorly. If the sheath be opened with care none of the above structures are endangered. The aneurism needle should be passed from the outer side. By separating or dividing the infra-hyoid muscles the artery may be tied below the omo-hyoid, in which case the skin

incision should be made a little lower down than above indicated.*

Ligature of the External Carotid.—

Incision along the anterior border of the sterno-mastoid extending from the hyoid bone to near the angle of the jaw. The sterno-mastoid being retracted as above, the lower part of the parotid gland must be pulled up and the lingual and facial veins held aside. The artery will then be seen below the posterior belly of the digastric and stylo-hyoid, crossed by the hypo-glossal nerve. It lies in front of the internal carotid and somewhat internal to it, and is distinguished from it by the branches it gives off; the internal jugular vein lies on its outer side; the superior laryngeal nerve lies behind it and to its inner side. The aneurism needle should be passed from the outer side.

COLLATERAL CIRCULATION.—There are such numerous and free anastomoses, in the face and neck, between the branches of the two external carotids, and at the base of the skull (circle of Willis), between the two internal carotids and the two subclavians (through the vertebrals), that it seems unnecessary to enumerate in detail the channels of collateral circulation in the case of the foregoing ligatures.

Ligature of the Lingual Artery.—Curved incision along the concavity of the two bellies of the digastric and the stylo-hyoid. Towards its middle

* In the ligature of the several arteries of the head and neck the neck should be extended and the face turned towards the opposite side.

the incision should correspond to the hyoid bone; posteriorly it should be prolonged towards (not to) the angle of the jaw; anteriorly it should be prolonged towards (not to) a point half an inch external to the symphysis menti. The skin, superficial fascia, platysma, and deep fascia being divided, the sub-maxillary gland will be exposed. This being freed and drawn up, the operator will look for the hypoglossal nerve as it runs on the surface of the hyoglossus muscle, and will define the small triangle which the nerve forms with the two bellies of the digastric and the stylo-hyoid, before it disappears beneath the mylo-hyoid. The lingual vein being drawn aside, the hyo-glossus is to be divided in this small triangular space, when the artery will be found beneath it.

The lingual artery may also be secured behind the posterior belly of the digastric and stylo-hyoid. It runs here between and parallel to both the hypo-glossal nerve, above, and the great cornu of the hyoid bone, below. A transverse incision a little above the great cornu of the hyoid bone having exposed the hyo-glossus muscle in the situation named, the division of the muscle between the hypo-glossal nerve and the great cornu of the hyoid bone will bring the artery into view.

In the operation on the living body the hyoid bone must be forcibly drawn down by hooks so as to save the soft parts from constant displacement through movements of deglutition.

Ligature of the Subclavian Artery, 3rd Part.—Shoulder depressed. The skin being drawn

down upon the middle third of the clavicle, divide it, with the superficial fascia and platysma, from the sterno-mastoid to the trapezius. Allowing the soft parts to retract, divide the deep fascia, being mindful of the external jugular vein at the inner extremity of the wound. The vein being retracted, and the outer part of the sterno-mastoid, if its clavicular origin is extensive, being divided, look for the posterior belly of the omo-hyoid, but without using the knife, as the situation of the transversalis humeri and transversalis colli arteries is very variable. Now feel downwards and inwards for the outer border of the scalenus anticus; this will lead down to the first rib and the scalene tubercle. The artery will be found resting on the rib behind the muscle and the tubercle. The cords of the brachial plexus lie above the artery. The vein lies below and in front of the artery, separated from it by the scalenus anticus. The aneurism needle should be passed from the outer side.

COLLATERAL CIRCULATION. — The *supra-* and *posterior scapular* arteries anastomose with the subscapular and with its dorsalis scapulae branch. The *intercostal arteries*, including the aortic intercostals, the superior intercostal from the first part of the subclavian, and the intercostal branches of the internal mammary, anastomose with the superior thoracic, with the long thoracic or external mammary, and with the thoracic branches of the acromio-thoracic and subscapular.

Ligature of the Innominate Artery, of the 1st Part of the Right Subclavian, and of the Lower Part of the Right Common

Carotid.—Two incisions are requisite to render these operations at all easy, one running for about two inches along the lower part of the anterior border of the sterno-mastoid, and another running for about the same distance along the upper border of the clavicle and the sternal fourchette. The sternal origin and part of the clavicular origin of the sterno-mastoid, and also the sterno-hyoid and -thyroid muscles being divided, the lower part of the right common carotid will be found in loose cellular tissue behind the inner extremity of the clavicle. This artery will lead down both to the innominate artery and to the first part of the right subclavian. Before, however, these vessels are reached there will have to be avoided and drawn aside—(1) internally, some of the inferior thyroid veins and the left innominate; (2) externally, the internal jugular vein and the right innominate; and (3) anteriorly, the pneumo-gastric nerve giving off the recurrent laryngeal. The aneurism needle should be passed from the outer side in the case of the innominate and the lower part of the carotid, from below in the case of the first portion of the subclavian, in which latter case injury to the pleura must be carefully avoided by keeping the aneurism needle close to the artery. In the case of the first portion of the subclavian, the ligature must be applied internally to the origin of the vertebral.

On the *left side* of the body a similar operation is legitimate with reference to the *carotid*, which, however, has the internal jugular vein closer to it, and more anterior, than is the case on the right side. With reference to the *first part of the subclavian*, the operation has also been performed, but only once, it is believed. The great depth of the artery, the extent to which it is covered by the pleura, the fact that it is crossed by the left innominate vein, and has both the pneumo-gastric nerve and the phrenic nerve in front of it, are circumstances which would deter most surgeons from undertaking the operation.

COLLATERAL CIRCULATION.—The remark made above in reference to the ligature of the carotids applies to the circulation of the right side of the head and neck, after ligature of the innominate. After this ligature, and after the ligature of the first part of the subclavian (internally to the vertebral), the circulation of the right upper limb would be carried on both through the inosculation of the two *vertebrals*, and through the collateral channels enumerated in the case of the ligature of the axillary.

Excision of the Eyeball.—The stop-speculum being introduced, pick up a fold of conjunctiva, and divide with blunt curved scissors, first the upper, then the lower segment of the membrane near the margin of the cornea. With a strabismus hook, pick up the tendons, and divide them. Passing the curved scissors behind the globe, divide the optic nerve. After removing the eyeball, bring together the edges of the wound in the conjunctiva with a few delicate stitches. It is sometimes recommended to divide the *external rectus* first, *leaving the tendon*

long enough for it to be grasped with the forceps. The eye being rotated so as to tense the several tendons, these may then be divided without their being raised with the strabismus hook; the optic nerve may then best be divided from the outer side, the eyeball being turned inwards.

Excision of One Half of the Upper Jaw.—Central incisor extracted. Incision along lower border of lower eyelid, along side of nose, round ala, through middle of upper lip. Dissect up the flap. Divide with saw or cutting pliers the malar bone into the speno-maxillary fissure, the nasal process of the superior maxilla, and the hard palate. Divide the soft palate transversely at its junction with the hard palate, and separate the structures of the orbit from the floor of that cavity. The upper jaw is now connected with the remainder of the skull only through the pterygoid process of the sphenoid. Seizing it with a lion forceps, wrench it out, tearing all remaining soft parts.

PARTS DIVIDED.—*On the face:* The orbicularis palpebrarum; the compressor nasi; the nasal portion of the levator labii superioris alæque nasi; the depressor alæ nasi; the orbicularis oris; the origins of the levator labii superioris alæque nasi, levator proprius labii superioris, levator anguli oris, zygomaticus minor, and buccinator; the angular, lateralis nasi, and superior coronary branches of the facial artery; the infra-orbital vessels and nerve; alveolar branches of the internal maxillary artery. *In connection with the eye:* Tenon's capsule; the origin of the inferior oblique muscle of the eyeball. *In connection with the nasal fossa and soft palate:* Branches of the olfactory and palatine nerves, of the descending and ascending palatine arteries, the azygos uvulæ, the

aponeurosis of the tensor palati, with, probably, portions of the palatoglossus, palato-pharyngeus, and levator palati. *Parts broken, torn, or divided at the finish:* Usually the lower part of the pterygoid process of the sphenoid, with the contiguous part of the palate bone; frequently portions of the lachrymal bone and of the os planum of the ethmoid; portions of the internal and external pterygoid muscles; the lachrymal sac; the infra-orbital vessels and nerve at their entrance into the infra-orbital canal.

Excision of One Half of the Lower Jaw.

—Central incisor extracted. Incision through middle line of lower lip, along lower border of body of jaw, and along lower half of posterior border of ramus,—not cutting higher than lobule of ear, lest the facial nerve be divided. The facial artery, divided in the horizontal incision, must be tied. Dissect up the tissues of the cheek and the masseter from off the outer surface of the jaw, opening up the cavity of the mouth. Saw the bone near the symphysis. (If not contra-indicated by the circumstances requiring the operation, it would be better to saw the bone half an inch from the symphysis, so as to leave the attachments of the genial muscles and the digastric, in which case one would extract the *lateral* incisor.) Separate the tissues of the floor of the mouth and the internal pterygoid muscle from the inner surface of the jaw, keeping the knife close to the bone so as not to endanger the lingual or gustatory nerve. Forcibly draw down the bone so as to project the coronoid process, and divide the temporal muscle (or, if the coronoid process be long, it may

be cut off with pliers); further depress the bone so as to project the condyle anteriorly, and divide the front part of the capsule. It is well to divide the inferior dental nerve at its entrance into the inferior dental canal; further parts of the capsule and some fibres of the external pterygoid may perhaps also be divided with advantage. But it must not be forgotten that more bleeding will follow cutting than tearing; on no account should the knife be carried near the internal maxillary artery. The soft parts being divided as far as may be found convenient or safe, the remaining connections should be torn by wrenching out the bone.*

PARTS DIVIDED.—*In median incision:* Orbicularis oris, with the inferior labial and inferior coronary arteries between it and the mucous membrane. *On the outer surface of the jaw:* Levator menti, depressores labii inferioris and anguli oris, buccinator, masseter; facial artery and vein, mental vessels and nerve, small branches of the submental artery, facial branches of the great auricular nerve. *On the inner surface of the jaw:* The genio-hyoid and genio-hyo-glossus and the anterior belly of the digastric (these muscles being saved if the section of the bone is made half an inch external to the middle line); the mylo-hyoid, the superior constrictor of the pharynx with the pterygo-maxillary ligament, the internal pterygoid muscle, the stylo-maxillary ligament. *Parts either torn or divided at the finish:* Capsule, with the internal and external lateral ligaments, external pterygoid muscle, & deeper part of the masseter.

Removal of the Tongue.†—"When, as usually happens, the cancerous disease involves one side of the organ, the operation may be satisfactorily performed as follows:—The patient being thoroughly

* When either jaw has to be removed for non-malignant disease, an effort may of course be made to save the periosteum.

† Condensed from Heath's "Operative Surgery."

under the influence of chloroform and efficiently gagged, two threads are to be passed through the tip of the tongue, one on each side of the median line. The tongue being drawn up with these, the frænum linguæ is to be divided with scissors, which are to be run along the floor of the mouth on the affected side, so as to divide the mucous membrane as far back as may be necessary. Giving the thread in the sound side of the tongue to an assistant, and holding the other himself, the operator divides the thick corium of the tongue strictly in the median line, and with his fingers tears through the muscular fibres so as to isolate the diseased half of the organ. Then, slipping the loop of the ecraseur over the diseased half, he carries it well back beyond the disease, and maintains the loop in position with the forefinger while slowly tightening up the wire or rope. When the disease extends far back, two or three needles in handles are to be made to transfix the whole thickness of the tongue well beyond the disease, and the wire is to be passed around them. It is well to leave the thread in the tongue for a few hours in case of the occurrence of hæmorrhage."

"*Removal of the Entire Tongue.*—May be performed with the ecraseur after the division of the organ into two halves as described above; or, if handled needles are passed through the base of the tongue, the ecraseur may be made to encircle the entire

organ, but with the drawback that, should the division be made too rapidly, both lingual arteries will be divided simultaneously and may bleed freely, the jets crossing one another, and making it difficult to secure the vessels."

"*Re* Professor Trendelenburg's proposal to perform a preliminary tracheotomy, and to plug the trachea by an expanding tampon, in all serious operations about the mouth. . . . The objection to this is that the pressure exerted on the trachea is apt to produce great embarrassment to breathing. Plugging the pharynx with a sponge to which a string is attached is a far preferable plan; and the preliminary tracheotomy, when considered necessary, should be done a couple of days beforehand, so that the patient's wind-pipe may have become accustomed to the pressure of the tube. A much more satisfactory plan, if it prove generally feasible, is that of Dr. McEwen, of Glasgow, to introduce a tracheal tube through the mouth for the administration of chloroform, the pharynx being plugged around the tube with sponge."

"*In cases of very extensive disease*, removal of the entire tongue may be most satisfactorily performed by dividing the lower jaw, so as to allow of the application of the ecraseur close to the hyoid bone. An incision in the median line of the lower lip, prolonged to the hyoid bone, will allow the dissection

of the lip from the jaw for about a quarter of an inch on each side. With a drill the bone can then be perforated on each side of the median line, so as to admit of the two halves being subsequently drawn together with wire. The jaw is then divided in the median line with a saw. The section need not be completed with the saw; but the bone forceps may be used for the purpose, the slight irregularity often resulting being advantageous in maintaining the parts in apposition. The halves of the bone should be held asunder while the operator cuts the genio-hyo-glossi muscles from the jaw with a pair of scissors, leaving the attachment of the genio-hyoid muscles. With the forefinger and scissors the tongue can then be dissected from the floor of the mouth, with the sublingual glands and mucous membrane, until the hyoid bone is reached, firm traction being made with a stout string passed through the tip. The tongue being then drawn down, the palato-glossi muscles will be put on the stretch, and must be divided with scissors, after which a handled needle, around which the wire should be passed, should be passed through the tongue close to the hyoid bone. The screw of the ecraseur should be worked very slowly, or hæmorrhage may occur, and would be difficult to arrest, since both lingual arteries would probably be divided at the same time."

"The operator should be prepared with a handled

needle and stout thread to transfix and hold the small remnant of tissue left attached to the hyoid bone, should the breathing be embarrassed by the epiglottis and base of the tongue falling back."

"All hæmorrhage having been checked, the two halves of the jaw are to be brought together with a piece of stout silver wire. The two halves of the lip are then drawn together with hare-lip pins and a fine silk stitch in the mucous membrane."

"The tongue may also be removed through the mouth with scissors only (Whitehead's method), care being taken to secure one lingual artery before the other is divided."

Laryngotomy. — Neck extended, head held accurately in the middle line; surgeon standing on right side of patient.* Incision in the middle line over the crico-thyroid membrane from three-quarters of an inch to an inch in length. Divide the crico-thyroid membrane horizontally close to the upper border of the cricoid cartilage. Introduce the laryngotomy tube. In case of urgency the transverse incision may be made at once into the larynx, and the wound may be kept open with a pair of scissors or two bent hairpins. The crico-thyroid arteries usually escape injury, and are too small, if divided, to cause any trouble.

* The above to apply also to the two following operations.

Tracheotomy above the Isthmus.—Median incision downwards from the upper border of the cricoid cartilage for an inch and a half or more. Dissection in the median line between the infra-hyoid muscles until the trachea is reached, the veins met with being pushed aside. Draw down the isthmus; fix the trachea by a sharp hook or tenaculum inserted below the cricoid cartilage; plunge the knife (held with the back downwards) into the trachea at the lowest part exposed, and cut upwards; compress the bivalve tracheotomy tube between forefinger and thumb, and slip it into the opening; introduce the inner tube and secure the whole with tapes round the neck. When the space between the isthmus and the cricoid cartilage is very small, as is the case in infants, it may be necessary to extend the incision through the cricoid cartilage, thus converting the operation into *laryngo-tracheotomy*.

There are generally no vessels of any importance upon the part of the trachea here operated upon, though there may be a loop between the two superior thyroid veins, which, however, may be divided without any great risk. Arterial hæmorrhage being arrested, it is unnecessary to wait for the cessation of venous hæmorrhage, it will cease as soon as respiration is re-established.

Tracheotomy below the Isthmus.—Median incision, begun over the isthmus and carried down to near the sternum. Dissection between the infra-hyoid muscles, continued mainly with the finger nail and handle of the scalpel. The isthmus of the

thyroid gland may be drawn up, or, if it is much in the way, it may be divided in the middle line without much danger of hæmorrhage. Trachea first fixed, and then divided from below upwards, as above explained, to the extent of three rings or more.

The *inferior thyroid veins* are usually a little to each side of the median line, and may be displaced during the operation; but cross branches must necessarily be divided. A modification of the operation, specially applicable when the isthmus of the thyroid gland is divided, consists in making a transverse cut along the lower border of the cricoid cartilage so as to divide the fascia covering the trachea, which, with the veins, may then be pushed down out of the way. The *thyroidæa ima artery* occasionally passes up in front of the trachea to the isthmus of the thyroid gland. The *left innominate vein* crosses the trachea below the top of the sternum in the adult, but in the child it usually rises higher. In infants the *thymus gland* usually rises a little above the sternum in the middle line, and higher still laterally, sometimes touching the thyroid gland; occasionally it remains largely developed up to or near puberty. The carotid arteries are on each side of the canal, which, it will be remembered, is much deeper below than above.

Œsophagotomy.—The œsophagus deviates to the left towards the lower part of the neck. It can here be reached by an incision along the anterior border of the sterno-mastoid, between the superior thyroid artery on the one hand, and the inferior thyroid artery and recurrent laryngeal nerve on the other. It should be opened longitudinally. If the canal be not distended by a foreign body, which the operation is intended to remove, it will be necessary that its walls be projected by the introduction of a catheter or some such instrument. A few stitches may be applied to the œsophagus, although they are really not necessary.

Trephining for Injury to the Head.*—

“In cases of punctured fracture, and of depressed fracture generally with symptoms of compression, the object of the surgeon is to raise the depressed bone without injuring the dura mater. Any loose pieces should therefore be carefully drawn away with forceps, and thus, very probably, room may be found for the introduction of the elevator. If there is no opening for the elevator it will probably be necessary to use the trephine.”

“On the living body, the wound, probably already existing, may be enlarged as far as may be necessary. On the subject a V-shaped (or curved) incision may be made. In making this incision the knife should divide the periosteum as well as the epicranial aponeurosis, and the handle of the scalpel should be employed to reflect the triangular flap so as to leave the surface of the bone bare, and to preserve the periosteum.”

“The point of application of the trephine should be chosen so that the pin and the major part of the circle of the trephine be on a margin of sound bone.”

“The trephine is to be worked evenly, so that one side should not go deeper than the other. It is well to use a probe or cut quill to clear the groove, and ascertain that the depth is regular all round. When the groove is sufficiently deep for the instrument to

* Condensed from Heath's "Operative Surgery."

maintain its position, the pin should be withdrawn. When the diploë is reached the sawdust will be discoloured with blood. After a few more turns, the trephine must be moved sharply from side to side so as to break off the piece of bone contained in it. The elevator must then be applied."

"The trephine may be applied in the temporal fossa for the relief of *hæmorrhage from the middle meningeal artery*. The incision should be made about an inch above the zygoma. The muscular fibres, with the periosteum, being scraped from the bone, a search is to be made for the line of fracture, and failing this, the crown of a large trephine may be applied about three-quarters of an inch from the external angular process of the frontal bone. Any clot exposed should be withdrawn, and hæmorrhage arrested by plugging the bony canal in which the artery lies."

The recent applications of the operation of trephining to cerebral surgery are beyond the scope of this little book.

OPERATIONS ON THE PERINÆUM AND MALE GENITO-URINARY ORGANS.

PERINÆAL LITHOTOMY.

Perinæum shaved; rectum emptied; bladder first emptied, and then injected with six or eight ounces of fluid; staff introduced, and *stone felt with staff*.

Lithotomy Position, i.e., buttocks projecting beyond edge of table, and hands secured, grasping feet; two assistants, one on each side, holding knees equally abducted; trustworthy assistant lifting up scrotum with his left hand, and holding staff with right hand, *accurately in middle line, and slightly depressed into perinæum*.

Lateral Lithotomy.—I. Knife entered a little to the left of the median raphé an inch and a half in front of the anus, *i.e.*, a little to the left of a point midway between the scrotum and the anus. Incision downwards and to the surgeon's right (patient's left) to a point midway between the anus and the tuberosity of the ischium,—*dividing* skin, superficial fascia, inferior hæmorrhoidal and superficial perinæal vessels and nerves.

II. Staff felt in upper part of wound with left fore-

finger ; surgeon cuts towards it, *dividing* posterior fibres of left accelerator urinæ, left transversus perinæi, probably left transverse perinæal artery ; perhaps a few fibres of the levator ani ; inferior layer of deep perinæal fasciæ.

III. Groove in staff felt through membranous portion of urethra with nail of left forefinger ; urethra punctured, *dividing* deep transversus perinæi, if it exist, and posterior fibres of compressor urethræ.

IV. Knife pushed onwards in groove in staff,—*dividing* membranous and prostatic portions of urethra, neck of bladder, and part of prostate gland.

V. Finger introduced into bladder ; stone felt with finger ; staff withdrawn ; forceps introduced ; stone extracted.

POSSIBLE ACCIDENTS.—The *bulb and its artery* may be divided if the incision is begun too far forwards. (It will be borne in mind that the artery of the bulb may lie further back than usual, and that there may be an accessory pudic artery difficult to avoid.) The *rectum* may be opened if it is not kept out of the way, or if the knife is turned too far inwards ; the *entire breadth of the prostate* with the pelvic fasciæ, the prostate plexus of veins, and the accessory pudic artery (if the latter exist) may be divided if the deep incision is too free ; the *pudic artery* may possibly be divided where it rests on the pudic arch.

The two *real dangers*, however, are allowing the knife to leave the groove in the staff, and tearing the urethra transversely so that the knife pushes the bladder backwards instead of opening it. In either case, the knife gets into the space between the bladder and the rectum, where any amount of damage may be done.

Before puberty, the prostate is rudimentary, the prostatic plexus of veins undeveloped, the perinæum, generally, thinner, and the kidney almost necessarily healthy. The operation is therefore much easier, and much more certain to succeed, than in the adult.

Other Perinæal Operations.—Median, Bilateral, Recto-Vesical.—Much interest once attached to the above, as in them was thought to lie the solution of the alternate questions, on the one hand, how best to remove *small* stones, and, on the other, how best to remove *very large* ones. But small stones are now invariably crushed, and, on the other hand, through the earlier recognition of stone in the bladder, and the improved treatment of stone by lithotrity, and more recently by lithalopaxy, those very large stones are no longer met with in practice which were of frequent occurrence some fifty years ago. The above-named operations are therefore now abandoned through the restriction of the area of applicability of perinæal lithotomy.

The Modern Supra-Pubic Operation, which bids fair to replace the lateral operation, differs from the old supra-pubic in that the rectum is now distended by a caoutchouc pouch, which pushes up the bladder (which latter must be distended with some six or eight ounces of fluid) from out of the pelvis into the abdomen. This raises the reflection of the peritoneum from the bladder to the anterior wall of the abdomen out of harm's way. Moreover, the lifting up of the fundus of the bladder greatly facilitates the extraction of the stone through the abdominal wound.

GENERAL VIEW OF THE TREATMENT OF STRICTURE,

INTRODUCING SOME OF THE OPERATIONS CALLED FOR
IN THESE CASES.

From the point of view of treatment, four classes of strictures may be recognised:—1. *Ordinary strictures.* 2. *Bad strictures.* 3. *Impassable strictures with retention.* 4. *Impassable strictures without retention.*

I.—ORDINARY STRICTURES may be treated by gradual or by rapid dilatation. *Gradual dilatation* is the introduction of catheters of gradually increasing size on successive or alternate days, the instruments being each left in *a short time only.* In

rapid dilatation, an instrument, usually a small one, is left in for twenty-four or forty-eight hours, at the expiration of which time a much larger one may generally be passed. Here the instrument exercises continuous pressure on the stricture, and causes relatively rapid absorption of the inflammatory products which have been poured out.

II.—By BAD STRICTURES are meant strictures which, on account of their resilient character, rapidly re-contract after having been dilated, or which cannot be dilated at all on account of the “urethral fever” and rigors, which ensue whenever an instrument is passed. There are three modes of treatment of this class of stricture:—*Syme’s perinæal section*, *internal urethrotomy*, and *forcible dilatation or “splitting.”*

III.—Cases of IMPASSABLE STRICTURE WITH RETENTION are generally chronic cases suddenly become acute through some irritation or other, and in which, if relief is not obtained by the simple means of a hot bath with full dose of laudanum, tapping must immediately be performed, either through the rectum or above the pubes. *Tapping through the rectum* (somewhat the less severe operation) is indicated when there is reason to believe that, on subsidence of the acute condition, the case will come under either I. or II. as above described. *Tapping above the pubes* is indicated when there is reason to fear that, after temporary

relief has been obtained, the stricture will still be impassable.

IV.—IMPASSABLE STRICTURE WITHOUT RETENTION.

Here the patient, who has suffered much and long, has generally obtained this degree of relief, that, while leading a quiet and abstemious life, and avoiding excitement of all kinds, he passes water fairly well; and, under the circumstances, if he deems it best to be satisfied with this much, one really cannot wonder at it. Unfortunately, he does not know,—and, while he feels relatively well, he is loth to believe the statement of his medical man,—that, even granting that he escapes acute attacks always on the list of possibilities, he is, through insufficiently free voidance of his urine, becoming more and more seriously every day the subject of kidney disease, which must necessarily shorten his life. In these cases the indications, all more or less unsatisfactory, are: (1) *patient perseverance in attempting to pass small instruments*, in the hope that some day or other an instrument may be got through the stricture, which would thus be brought under II.; (2) *puncture of the urethra in front of the prostate* (Cock's operation; (3) *perinæal section without a guide*, or, preferably, Wheelhouse's modification of the operation.

Syme's Perinæal Section.—Syme's shouldered staff introduced till the shoulder touches the front

or "face" of the stricture. Lithotomy position. Incision in middle line of perinæum in front of anus, blade being turned upwards, *i.e.*, from the anus; shoulder and groove (which latter begins in front of shoulder) felt with left forefinger and nail; urethra punctured; knife carried backwards along the groove till all resistance is overcome; staff, then a catheter, passed freely into bladder.

Puncture of the Bladder through the Rectum.—The bladder being distended, the reflection of the peritoneum from the rectum on to the bladder is raised to about four inches from the anus. The bladder may then be tapped safely behind the prostate, between the vesiculæ seminales and vasa deferentia:—Lithotomy position. Left fore finger in rectum feeling fluctuating fundus of bladder behind base of prostate; curved trocar introduced (point of trocar being concealed within canula); bladder punctured upwards and forwards, *i.e.*, in the direction of the umbilicus; canula secured to T bandage.

Puncture of the Bladder above the Pubes.—The bladder being distended, the reflection of the peritoneum from the bladder to the anterior wall of the abdomen is raised considerably. Small incision in middle line just above pubes passing between the recti and the pyramidales muscles; the

fluctuating surface of the bladder is then felt, and punctured.

Puncture of the Urethra in front of the Prostate.—Cock's Operation.—Left fore finger in rectum feels apex of prostate; perinæum punctured in middle line in front of rectum; transverse cut in front of apex of prostate dividing urethra transversely; short catheter passed through the wound into the bladder. The chances are that the stricture, being no longer irritated by the retention of urine, will become permeable, and the ease will fall under II. Should this not occur, the patient's micturition, as Mr. Cock puts it, would be assimilated to that of the other sex for the remainder of his life. Mr. Furneaux Jordan, having divided the urethra as above, passes a curved flexible bougie through the stricture from behind forwards.

Puncture of the Urethra in front of the Stricture, and Division of the Stricture from in front.—Wheelhouse's Operation.*—“The patient having been secured in the lithotomy position, Wheelhouse's staff is passed down to the stricture. The end of this is about the size of a No. 8 catheter; on one side it is flattened and grooved, and on the other it forms a small blunt hook, with

* From Erichsen's "Surgery."

which the upper end of the 'button-hole' incision in the urethra may be drawn upwards. The staff being passed and held with the grooved side forwards, the surgeon cuts down upon it by an incision about $1\frac{1}{2}$ in. long in the median line, and opens the urethra just above the stricture. The staff is now pushed out at the wound and turned round, so that the small hook is forwards; it is then drawn upwards so as to catch in the upper angle of the opening, and in this way the urethra is put on the stretch and steadied. If the special staff be not at hand, the end of a catheter can be cut down on with almost equal ease. The edges of the slit in the urethra are then seized in artery-forceps and held apart so as to expose the interior of the canal, which can be readily recognised by its smooth shining surface. It will often be found to be convenient to pass a silk suture through each side by which the edges may be held apart, as the forceps are rather apt to get in the way. Oozing having been allowed to cease, the aperture leading to the stricture will usually be found without very great difficulty. If a false passage have been opened instead of the urethra, it is recognised by the absence of the smooth pink mucous membrane. The orifice of the stricture must be sought for with a fine probe. Wheelhouse uses a small probe-pointed director. In some cases the small director used in slitting up the canaliculus will be found to pass when other instru-

ments have failed. In seeking the true orifice of the stricture every depression must be carefully explored without force. Pressure above the pubes will often cause a slight escape of urine, by which the proper orifice may be recognised. When the opening is found and the probe passed, the stricture must be divided along it with a fine knife or tenotome. Wheelhouse then passes a small gorget through the stricture, and along this a full-sized catheter can be easily guided into the bladder. It must be tied in and retained for a few days. This operation requires care and patience, but it is easier and safer than any other."

OPERATIONS ON THE FEMALE ORGANS.

The connections of the uterus to the vaginal wall and the peritoneum of the recto-vaginal and utero-vesical pouches may warrant the following brief outline of certain operations on the female genital organs.

Vaginal Amputation of the Cervix.—Applicable only when the disease is very limited. The cervix is seized with a vulsellum, and drawn down, when the diseased portion may be removed with either knife, scissors, or galvano-cautery, the latter means being the most satisfactory.

Supra - Vaginal Amputation of the Cervix.—Here the vaginal mucous membrane is divided, and the cervix is separated from its connections to the bladder; but *the peritoneum is not opened*. The cervix, and a wedge-shaped portion of the body of the uterus, can now be removed. The cut surfaces of the stump are united to the anterior and posterior walls of the vagina.

Hysterectomy, or Total Extirpation of the Uterus.—Here the cervix is cleared all round,

and *the peritoneum is divided*. The uterus is now drawn down so that the broad ligaments can be got at. These are transfixed with double ligatures,—externally to the Fallopian tubes and ovaries, if possible. The ligatures being tightened (Generally two ligatures are applied on each side for the sake of greater safety), the broad ligaments are divided between the ligatures and the uterus; and the latter is removed with the whole or a portion of its appendages.

Hysterotomy (Cæsarian Section), Oophorectomy.—Here the parts are reached, as is the ovary in ovariectomy, by a median incision through the linea alba. The details of these operations are clearly beyond the scope of this little book.

Amputation of the Breast.—Two curved incisions, embracing an elliptical portion of the skin of the breast along with the nipple, should be made in the direction of the fibres of the pectoralis major, which muscle should be put on the stretch by the arm being abducted. First the lower incision should be deepened, then the upper one. Both should be deepened till the stratum of loose cellular tissue is reached between the gland and the muscle. With a few touches of the knife the gland may then rapidly be raised from off the pectoralis major (that is, of

course, if no cancerous adhesions have formed). The vessels which enter the upper and outer part of the gland must be divided last, and immediately secured.

The wound may require to be prolonged upwards and outwards into the axilla for the removal of diseased glands. Unless the disease be very extensive, these will be found mainly beneath the edge of the pectoralis major. They should be removed with the finger and the handle of the scalpel, the knife being used most sparingly. In this way the axilla can be thoroughly cleared out with very little risk of hæmorrhage.

III.

100 TYPICAL VIVÂ VOCE QUESTIONS IN SURFACE MARKING, &c.

N.B.—With a little diligence, the student will find the answers to the following questions in Parts I. and II.

UPPER LIMB.

1. Feel the coracoid process, and demarcate the coraco-acromial ligament.

2. Feel, or indicate the position of, the greater & lesser tuberosities of the humerus, and the bicipital groove.

3. Explore the axilla, feeling specially for enlarged glands; name the muscles which form the folds of the axilla. What are the levels of the boundaries of the axilla?

4. Draw the line of the axillary artery, feel its pulsations, and compress it in the axilla. Compress it with Esmarch's india-rubber tubing, having first rendered the arm bloodless.

5. Draw the line of the circumflex nerve. Show where, and explain how, it emerges from a well-known space at the back of the axilla.

6. Draw the line of the musculo-spiral nerve.

7. Apply a tourniquet to the brachial artery in the middle of the arm. How would you tie the artery in this situation?

8. Trace the course of the cephalic & basilic veins, and map out the cutaneous veins at the bend of the elbow. Give the relations of the median

basilic vein; what serious accident may occur in bleeding from this vein?

9. Map out the triangular space at the bend of the elbow with the tendon of the biceps & the bicipital fascia, the median nerve and the brachial artery. Feel the pulsations of the brachial artery in the situation named. Stop the circulation in the artery by forcible flexion of the elbow.

10. Name the arterial anastomoses round the elbow. Point out the nerves round the elbow, other than the median.

11. Examine an elbow-joint for supposed disease or injury. Point out the relations of the internal & external condyles, and of the head of the radius; also those of the olecranon in the several positions of the joint.

12. How would you perform excision of the elbow-joint? How, in that operation, would you guard against injury of the ulnar nerve?

13. Point out the position of the supra-condylar lymphatic gland.

14. Draw the lines of the radial artery and radial nerve. Show in what part of the forearm the nerve accompanies the artery. How would you tie the radial artery in the several parts of its course?

15. Draw the lines of the ulnar nerve and ulnar

artery in the forearm, showing where they meet. Where and how would you tie the ulnar artery?

16. Show in action the flexor carpi radialis, palmaris longus, and flexor carpi ulnaris; and mark the position of the median nerve above the wrist.

17. Feel the head of the ulna and its styloid process. Feel the lower extremity of the radius and its styloid process. Which styloid process lies lowest? Name, and show in action, the tendons which groove the above.

18. Show the hollow of the "anatomical snuff-box." Draw the line of the radial artery in that situation. What superficial vein crosses it? Feel the joint of the metacarpal bone of the thumb.

19. Examine the wrist for supposed Colles's fracture. Demonstrate the relative positions of the two styloid processes (by grasping the wrist from side to side between thumb & index, with *finger-nails turned towards patient*).

20. Feel the tubercle of the scaphoid and the ridge of the trapezium; also the pisiform bone, and the unciform process of the unciform. Feel the cuneiform bone at the back of the wrist.

21. Show the position of the medio-carpal & radio-carpal joints, and the upper border of the anterior annular ligament of the wrist.

22. Point out in the palm of the hand the furrow which is of some use as a landmark, and state its significance.

23. Draw the line of the superficial palmar arch, and those of its superficial palmar interosseous or digital branches. Show the position of the deep palmar arch. What incisions can you safely make in the palm of the hand?

24. Mark out the synovial sheaths of the flexor tendons at the wrist and in the palm of the hand. Mark out the sheaths of the extensor tendons.

25. Draw the lines of the digital joints.

ABDOMEN.

26. Point out the *lineæ transversæ* and *semilunares*.

27. Show the direction of the fibres of the external oblique muscle; also of the internal oblique & transversalis, especially where they unite to form their conjoined tendon.

28. Feel the spine, crest, and symphysis pubis.

29. Map out the inguinal canal, and show the position of its rings.

30. Get your finger in the external abdominal ring, and describe what you feel.

31. Trace the course of the deep epigastric artery, its relations to the internal abdominal ring, and to oblique and direct inguinal herniæ.

32. Mark the point where the aorta bifurcates, and draw the lines of the common & external iliac arteries. How would you cut down upon these arteries?

33. Mark the position of the cardiac & pyloric orifices, and the portion of the stomach which is most accessible to the surgeon. How would you open the stomach?

34. Mark out the liver, and the fundus of the gall bladder.

35. See whether the spleen is enlarged.

36. How would you tap the bladder above the pubes? What is the essential difference between the old and the modern methods of supra-pubic lithotomy? How would you perform the latter operation?

37. Examine this patient for varicocele, and carefully isolate the vas deferens.

38. Mark out the kidneys; draw the incisions for cutting down upon the kidney, and for lumbar colotomy.

PERINÆUM.

39. Mark out the boundaries of the perinæum and those of the ischio-rectal fossa. Why is it specially urgent to open at once an abscess of the margin of the anus? Mark the position of the lower border of the gluteus maximus when the body is in the lithotomy position.

40. Put your finger on the central tendinous point of the perinæum. Draw the line of the incision for lateral lithotomy.

41. Pass your finger up the rectum, and examine for piles. See whether the prostate is enlarged. Feel for the fluctuating distended bladder behind the prostate, and between the vesiculæ seminales & vasa deferentia. How, and when, would you puncture the bladder in this situation?

42. Feel for the apex of the prostate, and explain how you would open the urethra in this situation (Cock's operation).

43. Point out the median raphé of the perinæum, and show where, and how, you make the incision for perinæal section.

LOWER LIMB.

44. Feel the pulsations of the femoral artery on the brim of the pelvis, and trace the course of the artery. Show in what places you can compress it. Compress it with Esmarch's india-rubber tubing, having first rendered the limb bloodless. Show the position of the femoral vein & anterior crural nerve.

45. So place the patient as to make evident the sartorius muscle. Define its relations to the femoral artery in Scarpa's triangle and in Hunter's canal. Where is the femoral vein in Hunter's canal? What nerve accompanies the artery, and where does it lie?

46. Put your finger on the saphenous opening. Explain its mode of formation, and the coverings of femoral hernia.

47. Point out situation of the femoral ring. What are its boundaries? Refer especially to the abnormal obturator artery.

48. Point out the great trochanter, and apply Nelaton's and Bryant's tests as to shortening of the lower limb. Compare the two limbs as to length.

49. Feel, or indicate the position of, the inguinal & femoral lymphatic glands.

50. Trace the course of the internal saphenous vein.

51. Show where the gluteal & sciatic arteries emerge from the pelvis.

52. Draw the line of the great sciatic nerve. How would you expose it?

53. Indicate the position of the bursa patellæ. What serious accident may occur in removing a hypertrophied bursa?

54. Mark the outline of the synovial membrane of the knee-joint, and examine the knee for fluid in the joint.

55. Point out the adductor tubercle. .

56. Mark out the boundaries of the popliteal space, and identify the tendons of the biceps, semitendinosus & semimembranosus, gracilis, and the ilio-tibial band.

57. Draw the line of the popliteal artery. What are its relations to the popliteal vein and to the internal popliteal nerve? Mark the position of the external popliteal nerve.

58. Indicate the bursæ at the back of the knee-joint. Which bursæ communicate, or may communicate, with the knee-joint?

59. Indicate the level at which the popliteal artery divides into anterior & posterior tibial, and the level at which the peroneal artery is given off from the latter.

60. Draw the line of the anterior tibial artery, and mention the muscles between which it lies in the upper, middle, and lower parts of its course. Where can you feel its pulsations? What is the relation of the anterior tibial nerve to the artery?

61. Draw the line of the posterior tibial artery. Feel its pulsations behind the internal malleolus. What are its relations to neighbouring structures in this situation?

62. Mark out the subcutaneous surface in the lower fourth of the fibula, and mention the muscles in front of and behind the bone at this level.

63. Show how you would put up a fractured leg. What part of the foot should be in a line with the inner border of the patella? What part should be in a line with the apex of the patella, the patellar ligament, and the spine of the tibia?

64. Mark the line of the ankle-joint, and show the position of the several fasciculi of the internal & external lateral ligaments.

65. Note the position of the internal & external malleoli, and draw the lines of the incisions for Syme's and Pirogoff's amputations.

66. Identify the following tendons : — *Tibialis anticus*, *extensor proprius pollicis*, *extensor longus digitorum*, *peroneus tertius*; *peronei longus & brevis*; *tibialis posticus & flexor longus digitorum*.

67. Draw the line, and feel the pulsation of the *dorsalis pedis* artery. Between what structures does it lie?

68. Draw the venous arch on the dorsum of the foot, and show the position of the internal & external saphenous veins in the vicinity of the ankle; also the position of the corresponding nerves. Trace the external saphenous vein to its termination.

69. Mark out, on the inner side of the foot, the lesser process of the *os calcis*, the tubercle of the scaphoid, the internal cuneiform bone, and the base of the first metatarsal bone.

70. Mark out, on the outer side of the foot, the tubercle of Chopart, and the base of the fifth metatarsal bone.

71. Draw the lines of the medio-tarsal and tarso-metatarsal articulations.

72. Draw the lines of the internal & external plantar arteries.

HEAD & NECK.

73. Feel the pulsations of the frontal, supraorbital, temporal, posterior auricular, and occipital arteries, and trace their course.

74. Trace the course of the supraorbital, supra-trochlear, auriculo-temporal, posterior auricular, and great & small occipital nerves.

75. Trace the lines of the superior longitudinal and lateral sinuses, and mark the lowest levels of the anterior, middle, and posterior lobes of the brain.

76. Find the bregma, trace the line of the fissure of Rolando, and indicate roughly the position of the cortical centres for the muscles of the upper and lower limbs, and the face.

77. Show where the anterior branch of the middle meningeal artery crosses the anterior inferior angle of the parietal. Point out the thickest and thinnest parts of the skull.

78. Look into the external auditory canal, and examine the membrana tympani.

79. Put your finger upon the infraorbital & mental foramina.

80. Draw the lines of the facial artery and its principal branches, and show where its, and their, pulsations can be felt. To what depth do you drive the pins in the suture for hare-lip, and why? Draw the line of the facial vein.

81. Show the course of the lachrymal canals, and indicate the position of the lachrymal sac. How would you open the latter? Show the tendo oculi. Feel the pulley of the superior oblique.

82. Draw the lines of Steno's duct, and of the facial nerve & its principal branches. How would you open an abscess over the ramus of the jaw? Find the aperture of Steno's duct in the mouth.

83. Show where, and how, you would tap the antrum.

84. Show the ranine veins, and indicate the position of the ranine arteries, and that of the sublingual artery on the floor of the mouth.

85. Examine the throat, and explore the posterior nares. Show externally the position of the tonsil. Where would you divide the gustatory nerve?

86. Trace the course of the external jugular vein.

87. Feel the hyoid bone, the thyroid & cricoid cartilages, and the crico-thyroid interval. Show the position of the lobes and isthmus of the thyroid gland. Mark out the incisions for laryngotomy, and for tracheotomy above and below the isthmus.

88. Draw the line of the common carotid artery, and compress the artery upon Chassaignac's tubercle. At what level is the artery crossed by the omohyoid? Where, and how, would you tie it?

89. Demarcate the triangle formed by the two bellies of the digastric & stylo-hyoid. Show the

position of the several structures it contains. How would you cut down upon the lingual artery?

90. Feel the pulsation of the subclavian artery, and compress the artery on the first rib. Where, and how, would you tie the artery? Indicate the position, with reference to the artery, of the vein, the cords of the brachial plexus, and the omo-hyoid muscle.

91. Mark the course of the chief superficial nerves of the neck, and that of the spinal accessory nerve.

THORAX.

92. Map out on the front of the chest the position of the heart and great arterial & venous trunks. Show how high the left innominate vein may rise in the child's neck.

93. Map out the lungs. Show how high the apex of the lung rises in the neck.

94. Show the point of division of the trachea.

95. Draw the line of the internal mammary artery.

96. Map out the pectoral muscles, and show the direction of their fibres.

97. Count the ribs & intercostal spaces, and show where you would tap the chest. Which rib can you immediately identify? (The second, since it lies opposite the transverse ridge which marks the

junction of the manubrium with the body of the sternum.) If called upon to do so, where would you tap the pericardium?

98. Count the spines of the vertebræ, and indicate the correspondences of the principal spines. How would you easily identify the spines of the third, eleventh, and twelfth dorsal, and fourth lumbar vertebræ?

99. Point out the vertebra prominens, and feel the bifid spine of the second cervical vertebra. Feel the transverse process of the atlas.

100. Mark out the scapula with its spine, and the acromion process.







